



## Tetra Tech EM Inc.

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155 467

January 22, 1998

Mr. Michael Bellot  
Work Assignment Manager (SR-6J)  
Remedial Response Unit No. 1  
U.S. Environmental Protection Agency Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

**Subject: Draft Site-Specific Plans for Natural Attenuation Evaluation and  
Split Sample Collection  
Blackwell Forest Preserve Landfill, DuPage County, Illinois  
Contract No. 68-W8-0084, Work Assignment (WA) No. 84-5P6Y**

Dear Mr. Bellot:

Tetra Tech EM Inc. (Tetra Tech), is submitting the draft site-specific plans for the above-referenced Alternative Remedial Contracting Strategy contract for the U.S. Environmental Protection Agency (EPA) Region 5. As you requested, Tetra Tech has prepared these plans to collect the data necessary to assist EPA in evaluating (1) natural attenuation at the Blackwell Forest Preserve Landfill site and (2) accuracy of analytical data obtained by the laboratory that the DuPage County Forest Preserve District will use. The approval pages of the draft quality assurance project plan and health and safety plan are not signed, but will be signed in the final version of these plans.

The plans were prepared in accordance with Section 1.2 of the EPA statement of work for work plan amendment No. 2 under the above-referenced WA.

If you have any questions regarding these plans, please call me at (312) 856-8757.

Sincerely,

Kostas Dovantzis, Ph.D., P.E., D.E.E.  
Site Manager

Enclosure

cc: Thomas Short, EPA Project Officer (letter only)  
Marguerite Hendrixson, EPA Contracting Officer (letter only)  
Majid Chaudhry, Tetra Tech Program Manager

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**DRAFT SITE-SPECIFIC PLANS FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

**Prepared for  
U.S. Environmental Protection Agency  
Region 5  
Chicago, Illinois**

Work Assignment No.	:	84-5P6Y
Contract No.	:	68-W8-0084
Tetra Tech No.	:	030-008401RA
EPA Work Assignment Manager	:	Michael Bellot
Telephone No.	:	(312) 353-6425
Date Prepared	:	January 22, 1998
Prepared by	:	Tetra Tech EM Inc.
Tetra Tech Site Manager	:	Kostas Dovantzis
Telephone No.	:	(312) 856-8757

## Draft Site-Specific Plans

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## **FOREWORD**

**Tetra Tech EM Inc. has prepared draft site-specific plans for the Blackwell Forest Preserve Landfill site in Warrenville, DuPage County, Illinois, in fulfillment of the U.S. Environmental Protection Agency (EPA) statement of work (SOW) for work plan Amendment No. 2 under Alternative Remedial Contracting Strategy Contract No. 68-W8-0084, Work Assignment No. 84-5P6Y, for EPA Region 5. The site-specific plans were prepared in accordance with Section 1.2 of the EPA SOW for performing an evaluation of (1) natural attenuation at the Blackwell Forest Preserve Landfill site and (2) the accuracy of analytical data obtained by the laboratory that the DuPage County Forest Preserve District will use. As specified in the EPA SOW, these plans consist of a (1) draft sampling and analysis plan (SAP) and (2) draft health and safety plan. These plans follow this foreword.**

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DRAFT HEALTH AND SAFETY PLAN	

## LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

°C	Degree Celsius
%R	Percent recovery
<	Less than
AFCEE	Air Force Center for Environmental Excellence
ARCS	Alternative Remedial Contracting Strategy
ASTM	American Society for Testing and Materials
Blackwell	Blackwell Forest Preserve Landfill
CH <sub>4</sub>	Methane
CLP	Contract Laboratory Program
CO <sub>2</sub>	Carbon dioxide
CRL	Central Regional Laboratory
CRQL	Contract-required quantitation limit
CRDL	Contract-required detection limit
DQO	Data quality objective
EMSL	Environmental Monitoring Systems Laboratory
EPA	U.S. Environmental Protection Agency
FPD	Forest Preserve District
FSP	Field sampling plan
HCl	Hydrochloric acid
HNO <sub>3</sub>	Nitric acid
H <sub>2</sub> SO <sub>4</sub>	Sulfuric acid
HSP	Health and safety plan
IAC	Illinois Administrative Code
IDW	Investigation-derived waste
LCS	Leachate collection system
MCL	Maximum contaminant level
mg/L	Milligram per liter
mL	Milliliter
MS	Matrix spike
MSD	Matrix spike duplicate
MW	Montgomery Watson, Inc.
NPL	National priorities list

O <sub>2</sub>	Oxygen
ORP	Oxidation-reduction potential
PCE	Tetrachloroethene
ppbv/v	Parts per billion by volume
PRQL	Project-required quantitation limit
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
RAS	Routine analytical services
RI	Remedial investigation
RPD	Relative percent difference
RSCC	Regional sample control coordinator
SAP	Sampling and analysis plan
SAS	Special analytical services
SMCL	Secondary maximum contaminant level
SOP	Standard operating procedure
SOW	Statement of work
SVOC	Semivolatile organic compound
TCE	Trichloroethene
Tetra Tech	Tetra Tech EM Inc.
TSS	Technical Support Section
μg/kg	Microgram per kilogram
μg/L	Microgram per liter
USGS	U.S. Geological Survey
VOC	Volatile organic compound
WA	Work assignment
WAM	Work assignment manager
Warzyn	Warzyn, Inc.

**Draft Sampling and  
Analysis Plan**

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**DRAFT SAMPLING AND ANALYSIS PLAN FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

**Prepared for  
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Tetra Tech Site Manager	:	Kostas Dovantzis
Telephone No.	:	(312) 856-8757

## **FOREWORD**

Tetra Tech EM Inc. has prepared this draft sampling and analysis plan (SAP) for the Blackwell Forest Preserve Landfill site in Warrenville, DuPage County, Illinois, in fulfillment of the U.S. Environmental Protection Agency (EPA) statement of work (SOW) for work plan Amendment No. 2 under Alternative Remedial Contracting Strategy Contract No. 68-W8-0084, Work Assignment No. 84-5P6Y, for EPA Region 5. The SAP is part of the site-specific plans specified in Section 1.2 of the EPA SOW and was prepared for performing an evaluation of (1) natural attenuation at the Blackwell Forest Preserve Landfill site and (2) the accuracy of analytical data obtained by the laboratory that the DuPage County Forest Preserve District will use. As specified in the EPA SOW, these plans consist of the (1) quality assurance project plan (QAPP) in Appendix A, and (2) field sampling plan (FSP) in Appendix B. The QAPP and FSP follow this foreword.



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A	DRAFT QUALITY ASSURANCE PROJECT PLAN
B	DRAFT FIELD SAMPLING PLAN

**Appendix A - Dra  
Quality Assurance  
Project Plan**

**APPENDIX A**

**DRAFT QUALITY ASSURANCE PROJECT PLAN FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

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**QUALITY ASSURANCE PROJECT PLAN**  
**FOR NATURAL ATTENUATION EVALUATION**  
**AND SPLIT SAMPLE COLLECTION**  
**AT**  
**BLACKWELL FOREST PRESERVE LANDFILL**  
**DuPAGE COUNTY, ILLINOIS**

**REVISION 0**

**JANUARY 22, 1998**

**PREPARED BY: TETRA TECH EM INC. (TETRA TECH)**

\_\_\_\_\_  
Tetra Tech Site Manager

\_\_\_\_\_  
Date

\_\_\_\_\_  
Tetra Tech QA Officer/Reviewer

\_\_\_\_\_  
Date

\_\_\_\_\_  
Laboratory QA Manager (if applicable)

\_\_\_\_\_  
Date

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Illinois Environmental Protection Agency Project Manager

\_\_\_\_\_  
Date

\_\_\_\_\_  
U.S. Environmental Protection Agency Region 5  
Remedial Project Manager/Work Assignment Manager

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Date

\_\_\_\_\_  
U.S. Environmental Protection Agency Region 5  
Quality Assurance Reviewer

\_\_\_\_\_  
Date

**APPENDIX A**

**DRAFT QUALITY ASSURANCE PROJECT PLAN FOR**  
**BLACKWELL FOREST PRESERVE LANDFILL**  
**DuPAGE COUNTY, ILLINOIS**

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## **SECTION 1**

### **PROJECT DESCRIPTION**

#### **1.1 INTRODUCTION**

This quality assurance project plan (QAPP) has been prepared in fulfillment of the requirements of the U.S. Environmental Protection Agency (EPA) statement of work (SOW) for Work Assignment (WA) No. 84-5P6Y under the Alternative Remedial Contracting Strategy (ARCS) Contract No. 68-W8-0084 for Region 5. As required by Section 1.2.3 of the EPA SOW for work plan Amendment No. 2, Tetra Tech EM Inc. (Tetra Tech) has prepared this QAPP to describe sample collection and analysis activities necessary to assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell Forest Preserve Landfill (Blackwell) in Warrenville, DuPage County, Illinois. Removal action construction, operation, maintenance, and performance monitoring at the site are performed by the responsible party for the site, DuPage County Forest Preserve District (FPD). Removal action at the site consists of landfill cap repairs, a leachate collection system (LCS), and landfill gas venting system, and will be completed in the spring of 1998. In addition, the QAPP describes split sampling and analysis of surface water, soil, and sediment to assess the analytical accuracy of the laboratory used by FPD. The QAPP is prepared in accordance with EPA requirements outlined in (1) "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" (QA/R-5; EPA 1994c), (2) "Region 5 Superfund Model Quality Assurance Project Plan" (EPA 1996a), and (3) the 1997 EPA Directive 9200.4-17 entitled "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites."

This QAPP consists of the following 14 sections: (1) Section 1, Project Description; (2) Section 2, Project Organization and Responsibilities; (3) Section 3, Quality Assurance (QA) Objectives for Measurement Data; (4) Section 4, Sampling Procedures; (5) Section 5, Custody Procedures; (6) Section 6, Calibration Procedures and Frequencies; (7) Section 7, Analytical Procedures; (8) Section 8, Internal Quality Control (QC) Checks; (9) Section 9, Data Reduction, Validation, and Reporting; (10) Section 10, Performance and System Audits; (11) Section 11, Preventive Maintenance Procedures; (12) Section 12, Assessment of Data Precision, Accuracy, and Completeness; (13) Section 13, Corrective Actions; and (14) Section 14, QA Reports to Management. References used to prepare the QAPP are provided at the

end of the QAPP. The QAPP is Appendix A of the sampling and analysis plan (SAP) for this WA. Appendix B provides the field sampling plan (FSP), which discusses sampling procedures. Page numbering in the QAPP is consistent with the Region 5 Superfund model QAPP. Page numbering of the FSP is preceded by "B" to indicate that the FSP is Appendix B to the SAP.

Besides this introduction, Section 1 discusses the site description and history, past data collection activities, current site status, project objectives, sample network design and rationale, and proposed project schedule.

## **1.2 SITE DESCRIPTION AND HISTORY**

The site description and history, including site topography and local geology and hydrology, is presented in Section 2.0 of the FSP. Figure B-1 presents a site location map. Figure B-2 presents the site layout and proposed groundwater and leachate sampling locations. Figure B-3 presents soil sampling locations at the north stormwater collection pipe area.

## **1.3 PAST DATA COLLECTION ACTIVITIES**

Past data collection activities at the Blackwell site were conducted primarily during the remedial investigation (RI). These activities are discussed in Section 2.0 of the FSP.

## **1.4 CURRENT SITE STATUS**

The current Blackwell site status is discussed in Section 2.0 of the FSP.

## **1.5 PROJECT OBJECTIVES**

The objectives of this investigation are to (1) gather necessary data to assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell site and (2) conduct split sampling and analysis of surface water, soil, and sediment to assess the analytical accuracy of the laboratory used by FPD. If FPD performs leachate and groundwater sampling for evaluating natural attenuation, up to four

split samples of groundwater will also be collected and analyzed to assess the FPD laboratory's analytical accuracy. Tetra Tech will also independently evaluate the occurrence of natural attenuation based on FPD's analytical results.

Table B-1 of the FSP summarizes compounds detected in groundwater, leachate, and soil gas during the RI conducted at the site. As Table B-1 indicates, leachate and groundwater at the site contain a variety of aromatic, chlorinated-aromatic, and chlorinated-solvent compounds and their degradation products, which are the target organic parameters for evaluating natural attenuation. To assess natural attenuation, Tetra Tech will collect and analyze groundwater and leachate samples for the target parameters and geochemical indicator parameters indicated in Table 1-1. In addition, soil gas will be measured in the field for methane ( $\text{CH}_4$ ), carbon dioxide ( $\text{CO}_2$ ), and oxygen ( $\text{O}_2$ ). Analysis of target parameters will be used to assess whether there is a decreasing trend in target parameter concentrations. Analysis of geochemical indicator parameters will help assess whether in situ biodegradation (natural attenuation) of the target organic parameters is occurring. Natural attenuation will be assessed in accordance with "Proceedings of the Symposium of Natural Attenuation of Chlorinated Organics in Ground Water" (EPA 1997) and "Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater" (AFCEE 1995). The following is a brief discussion of the information presented in these references.

Dissolved oxygen concentrations in leachate and groundwater will be compared to background conditions to help evaluate whether aerobic or anaerobic degradation is occurring. Also, if reduced nitrate and sulfate concentrations and elevated ferrous iron concentrations compared to background concentrations are observed, this trend will identify areas in leachate or groundwater where anaerobic degradation is occurring. This data may also imply that the analytes are being used as electron acceptors by naturally occurring bacteria to help mediate biological reactions of the target organic compounds, which act as electron donors and as a carbon source for the bacteria. Depressed pH in leachate and groundwater may be the result of organic acids generated as intermediate products of the oxidation of target organic parameters. Depressed oxidation reduction potential (ORP) would indicate areas where leachate and groundwater degradation is occurring under reduced conditions. Elevated alkalinity

**TABLE 1-1**  
**PARAMETER, ANALYTE, LABORATORY, AND INTENDED DATA USE SUMMARY**

Page 1 of 2

Parameter	Analyte	Laboratory	Intended Data Use
Groundwater			
Target <sup>a</sup>	Metals <sup>b</sup>	CLP	Groundwater samples will be analyzed to (1) assess whether natural attenuation of contaminants is occurring at the site, (2) associate contaminants detected in the landfill to contaminants detected in downgradient monitoring wells, and (3) estimate the rate of contaminant in situ biodegradation.
	VOCs and SVOCs <sup>c</sup>	CLP	
Geochemical Indicator	Conductivity	Field	Analytical data from four groundwater samples will also be used to perform a QC check of the analytical accuracy of the FPD laboratory.
	Dissolved oxygen	Field	
	Temperature	Field	
	pH	Field	
	ORP	Field	
	Ferrous iron	Field	
	Alkalinity	CRL	
	Nitrate	CRL	
	Sulfate	CRL	
	Chloride	CRL	
CH <sub>4</sub> , ethane, and ethene	CRL		
Leachate			
Target	VOCs and SVOCs <sup>d</sup>	CLP	Leachate samples will be analyzed to (1) assess whether natural attenuation of contaminants is occurring at the site, (2) associate contaminants detected in the landfill to contaminants detected in downgradient monitoring wells, and (3) estimate the rate of contaminant in situ biodegradation
Geochemical Indicator	Conductivity	Field	
	Dissolved oxygen	Field	
	Temperature	Field	
	pH	Field	
	ORP	Field	
	Ferrous iron	Field	
	Alkalinity	CRL	
	Nitrate	CRL	
	Sulfate	CRL	
	Chloride	CRL	
	CH <sub>4</sub> , ethane, and ethene	CRL	

**TABLE 1-1**  
**PARAMETER, ANALYTE, LABORATORY, AND INTENDED DATA USE SUMMARY**

Page 2 of 2

Parameter	Analyte	Laboratory	Intended Data Use
Soil Gas			
Geochemical Indicator	CH <sub>4</sub>	Field	Soil gas samples will be analyzed to assess whether in situ degradation of contaminants is occurring at the site.
	CO <sub>2</sub>	Field	
	O <sub>2</sub>	Field	
Soil, Sediment, and Surface Water			
Target	Metals <sup>b</sup>	CLP	Analytical data from these samples will be used to perform a QC check of the analytical accuracy of the FPD laboratory.
	VOCs and SVOCs <sup>d</sup>	CLP	

Notes:

CH<sub>4</sub> Methane  
CLP Contract Laboratory Program  
CO<sub>2</sub> Carbon dioxide  
CRL Central Regional Laboratory  
FPD Forest Preserve District

O<sub>2</sub> Oxygen  
ORP Oxidation-reduction potential  
QC Quality control  
SVOC Semivolatile organic compound  
VOC Volatile organic compound

- <sup>a</sup> All groundwater samples collected by Tetra Tech will be analyzed for VOCs and SVOCs. Four of these samples will be analyzed for metals. If FPD collects groundwater and leachate samples for evaluating natural attenuation, Tetra Tech will obtain four groundwater split samples and analyze them for VOCs, SVOCs, and metals.
- <sup>b</sup> Target analytes are listed in the CLP SOW ILM04.0 (or its most current version) for metals.
- <sup>c</sup> Target analytes are listed in the CLP SOW OLC02.1 (or its most current version) for VOCs and SVOCs.
- <sup>d</sup> Target analytes are listed in the CLP SOW OLM03.2 (or its most current version) for VOCs and SVOCs.

concentrations would indicate areas of increased biodegradation as a result of the generation of CO<sub>2</sub> when target organic contaminants are degraded. The generation of ethene, ethane, and CH<sub>4</sub> in leachate or groundwater may indicate the breakdown of chlorinated organic compounds such as tetrachloroethene (PCE) and trichloroethene (TCE) to vinyl chloride, which then break down to ethene, ethane, and CH<sub>4</sub>. Elevated chloride concentrations may indicate the dechlorination of chlorinated organic compounds.

Also, measuring CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> in soil gas at shallow monitoring wells, and shallow and deep leachate vents will provide further information about whether in situ biodegradation of target parameters is occurring. The presence of decreased oxygen concentrations and elevated CH<sub>4</sub> and CO<sub>2</sub> concentrations would indicate anaerobic degradation, which has been shown in RI data.

Tetra Tech will also collect split samples of surface water, sediment, and soil. If FPD collects the leachate and groundwater samples for evaluating natural attenuation, Tetra Tech will collect four split groundwater samples. Tetra Tech will analyze the split samples for the target parameters in Table 1-1 to assess the FPD's laboratory's analytical accuracy. Tetra Tech will assess the FPD's laboratory's analytical accuracy by comparing its split sample results to the FPD's laboratory's sample results. Tetra Tech will also perform an independent evaluation of natural attenuation based on analytical results obtained by FPD. If Tetra Tech collects leachate and groundwater samples, Tetra Tech will coordinate its sampling program for assessing natural attenuation with the FPD.

The following sections describe (1) specific objectives and associated tasks, (2) project target parameters and intended data usages, and (3) quality objectives and criteria for measurement data.

#### **1.5.1 Specific Objectives and Associated Tasks**

To meet the project objectives of this site investigation, Tetra Tech will (1) collect samples of leachate and groundwater for analysis of target and geochemical indicator analytes; (2) measure on-site CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> concentrations in soil gas at existing shallow monitoring well locations, and shallow and deep leachate vent locations; and (3) use the analytical data from steps (1) and (2) to independently evaluate natural attenuation. In addition, if FPD collects groundwater and leachate samples and conducts its own



evaluation of natural attenuation, Tetra Tech will use FPD's analytical data to evaluate whether the data supports the occurrence of natural attenuation.

Tetra Tech will also obtain split samples of surface water, sediment, and soil from FPD and analyze these samples at an off-site laboratory to evaluate FPD's analytical laboratory's accuracy. The tasks described below assume that Tetra Tech will conduct the leachate and groundwater sampling to evaluate natural attenuation. Tasks associated with each of these activities are discussed below.

#### **1.5.1.1 Natural Attenuation Sampling and Analysis**

Sampling and analysis for evaluation of natural attenuation at the Blackwell site will consist of sampling and analyzing groundwater and leachate. Sampling locations for these matrices are presented in Figure B-2 of the FSP. Soil gas will be screened in the field for CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> at the shallow groundwater monitoring well locations, and shallow and deep leachate vent locations presented in Figure B-2.

#### **Groundwater**

Groundwater samples will be collected from shallow and deep monitoring wells, for the target and geochemical indicator analytes listed in Table 1-1 of the QAPP, and analyzed either on site, at an off-site Contract Laboratory Program (CLP) laboratory, or at the Region 5 Central Regional Laboratory (CRL). Target and geochemical indicator analytes that will be evaluated are discussed in Section 1.5.2 and presented in Table 1-1 of the QAPP. Sampling rationale, procedures, and locations and the number of samples to be collected are described in detail in the companion FSP, which is Appendix B of the SAP.

#### **Leachate**

Leachate samples will be collected from existing shallow vents and deep vents, for the target and geochemical analytes listed in Table 1-1 of the QAPP, and analyzed either on site, at an off-site CLP laboratory or at the Region 5 CRL. Target and geochemical indicator analytes that will be evaluated are discussed in Section 1.5.2 and presented in Table 1-1 of the QAPP. Sampling rationale, procedures, and

locations and the number of samples to be collected are described in detail in the companion FSP, which is Appendix B of the SAP.

### **Soil Gas**

Geochemical indicator analytes in soil gas will be measured on site at shallow and deep leachate vents and shallow groundwater monitoring wells. Geochemical indicator analytes that will be evaluated are discussed in Section 1.5.2 and presented in Table 1-1 of the QAPP. No soil gas samples will be collected for off-site analysis of target analytes. The sampling rationale and number of field measurements to be made for the geochemical indicator analytes are described in detail in the companion FSP, which is Appendix B of the SAP.

#### **1.5.1.2 Split Sampling and Analysis**

Tetra Tech will obtain split samples of surface water, sediment, and soil samples from the samples to be collected by FPD as discussed below. Tetra Tech will also obtain four split groundwater samples from FPD, if FPD performs the leachate and groundwater sampling for evaluating natural attenuation. Soil split sampling locations are shown in Figure B-3 of the FSP.

### **Groundwater**

If FPD assumes primary responsibility for natural attenuation sampling, Tetra Tech will obtain four groundwater split samples from the samples to be collected by the FPD. Target analytes are discussed in Section 1.5.2. Sampling rationale, procedures, and locations and the number of samples to be collected are described in detail in the companion FSP, which is Appendix B of the SAP.

### **Surface Water and Sediment**

One surface water split sample and one sediment split sample will be obtained from FPD and analyzed by an off-site CLP laboratory or the Region 5 CRL. Target analytes that will be evaluated are discussed

in Section 1.5.2. No geochemical indicator analytes will be evaluated. Sampling rationale, procedures, and locations and the number of samples to be collected are described in detail in the companion FSP, which is Appendix B of the SAP.

## **Soil**

Four soil split samples will be obtained from FPD. These samples will be obtained from the six soil sampling locations proposed by FPD. Soil split samples will be analyzed by an off-site CLP laboratory. Target analytes that will be evaluated are discussed in Section 1.5.2. No geochemical indicator analytes will be evaluated. Sampling rationale, procedures, and locations and the number of samples to be collected are described in detail in the companion FSP, which is Appendix B of the SAP.

### **1.5.2 Project Parameters and Intended Data Usages**

Tetra Tech intends to use target and geochemical indicator analytical data to (1) assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell site and (2) assess the analytical accuracy of the laboratory used by FPD. To comply with the first intended data use, Tetra Tech will evaluate trends in the analytical data for the target organic parameters described in Section 1.5.1 of this QAPP. To evaluate trends in target VOC concentrations, Tetra Tech will use analytical data presented in the RI report (Warzyn 1994) and data obtained by Tetra Tech as part of the evaluation of natural attenuation. The geochemical indicator analytical data will be used as described in Section 1.5 of the QAPP to perform a qualitative assessment of natural attenuation. In addition, Tetra Tech will use a groundwater analytical model such as PLUME to simulate the fate and transport of target chlorinated volatile organic compounds (VOC) that have been detected at downgradient monitoring wells and at off-site residential wells during the RI. Results of the modeling effort will be used to supplement the analytical data collected and assist EPA in making a decision on the adequacy of natural attenuation as a remedial action for groundwater at the site.

Data needed as input to the model, such as groundwater velocity, retardation coefficients, and dispersivities will be obtained from the RI report (Warzyn 1994). The first-order degradation rate

constants (lumped parameters) for the target chlorinated VOCs detected at downgradient monitoring wells and off-site residential wells will be estimated based on chlorinated VOC data collected during the RI (Warzyn 1994) and corresponding data collected by Tetra Tech as part of the evaluation of natural attenuation. These degradation rate constants will be estimated at seven leachate sampling locations to account for the size of the landfill and the heterogeneous nature of leachate. An average, site-specific, first-order, degradation rate constant for each chlorinated VOC will be calculated for leachate in the landfill to estimate the mass of these VOCs leaking from the landfill to groundwater as a function of time. To estimate the mass of VOCs, Tetra Tech will also use the leachate generation rate (approximately 10,000 gallons per day based on the RI report [Warzyn 1994]). The first-order degradation rate constants for the VOCs in the aquifer downgradient of the landfill will be estimated, through a quasi-calibration process, by adjusting the degradation rate constants until existing VOC concentration data match model predictions. Degradation rate constants for the aquifer from the quasi-calibration will be compared to constants in scientific literature (EPA 1997). The degradation rate constants obtained as described above will then be used as input to the PLUME model to predict changes in downgradient chlorinated VOC concentrations with time.

To comply with the second intended data use, Tetra Tech will compare its split sampling analytical data to the split sampling analytical data of the FPD laboratory. Table 1-1 summarizes the target and geochemical indicator analytes that will be evaluated for each matrix.

### **1.5.3 Quality Objectives and Criteria for Measurement Data**

Data quality objectives (DQO) are designed to ensure that the type, quality, and quantity of environmental data used in decision-making are appropriate for their intended application. The environmental data to be used for decision-making related to field investigation activities at the site are groundwater, leachate, soil gas, soil, surface water, and sediment sampling results. DQOs are qualitative and quantitative statements that (1) clarify the study objective, (2) define the most appropriate type of data to collect, and (3) determine the most appropriate conditions under which to collect the data. The process of determining DQOs includes the following seven steps:

- Identify the problem
- Identify the decision
- Identify inputs to the decision
- Define study boundaries
- Develop a decision rule
- Specify limits on decision errors
- Optimize the design for obtaining data

Each step of the DQO process is described below.

#### **1.5.3.1 Identify the Problem**

This step of the DQO process involves identifying the purpose of collection activities. Previous RI data collected by FPD at the Blackwell site indicate that target VOC concentrations decrease significantly at downgradient monitoring well locations compared to shallow and deep leachate vent locations (Warzyn 1994). These data suggest that, in addition to dilution, natural attenuation may significantly reduce the concentrations of target VOCs, such as benzene, toluene, ethylbenzene, xylenes, and chlorinated solvents, such as PCE and TCE. Natural attenuation mechanisms include dispersion, advection, sorption, volatilization, oxidation, and in situ degradation. As suggested in the scientific literature, the main natural attenuation mechanisms for target VOCs in an aquifer are sorption and in situ biodegradation. Sorption may not alter the chemical structure or toxicity of the VOCs, and may be reversible, causing contaminant desorption into the groundwater. To support the conclusion that natural attenuation is occurring, in addition to the target VOC data, it is important to collect data on the geochemical indicator analytes that indicate in situ degradation. Furthermore, based on the data collected, it is important to document the rate of in situ degradation of target VOCs in order to predict contaminant concentrations as a function of time and location from the source (the landfill). The data and approach described in Section 1.5.2 of the QAPP will be used to (1) estimate the time it will take for groundwater target VOC concentrations at the downgradient property boundary to decline to below maximum contaminant levels (MCL) (EPA 1996b) or potable resource groundwater criteria for Class I aquifers specified in Title 35 of

the Illinois Administrative Code (IAC), Section 620.410, and (2) evaluate future target VOC concentrations at affected off-site residential wells.

To meet these objectives and to assist EPA in deciding whether natural attenuation is a potentially effective remedial action for groundwater at the site, EPA has tasked Tetra Tech to perform an independent evaluation of natural attenuation at the Blackwell site.

#### **1.5.3.2 Identify the Decision**

The goal of this DQO determination process step is to combine the principal study questions for field investigation activities with alternative actions to determine the decision statement. For the Blackwell site, the principal study question for the field investigation is "What is the time period necessary for natural attenuation to reduce groundwater contaminant concentrations to below MCLs or groundwater quality standards specified in IAC for the Class I aquifer at the FPD property boundary?" If it is determined that natural attenuation cannot reduce target VOC concentrations to below MCLs or IAC criteria for the Class I aquifer in a time period comparable to that of other remedial alternatives, alternative remedial actions may need to be implemented. Therefore, the decision statement for the field investigation is "Determine whether natural attenuation is a potentially effective remedial action for reducing groundwater target VOC concentrations at the site."

#### **1.5.3.3 Identify Inputs to the Decision**

The inputs required to address the decision statement include validated laboratory data for the project target and geochemical indicator analytes, field measurement data, and groundwater modeling data necessary to evaluate natural attenuation. In addition, the data and approach described in Section 1.5.2 of the QAPP will be used for this evaluation.

#### **1.5.3.4 Define Study Boundaries**

The purpose of this step is to define the spatial and temporal boundaries of the study and to identify any practical constraints that may interfere with groundwater, leachate, soil gas, surface water, soil, and sediment sampling. Samples of these matrices will be collected from the locations shown in Figures B-2 and B-3 of the FSP within the FPD property boundary. According to EPA, none of the groundwater wells proposed to be sampled during this investigation have been abandoned. However, the condition of leachate vents and groundwater monitoring wells from which leachate and groundwater samples will be collected, and where soil gas measurements will be made, will be evaluated prior to sampling, and alternative locations will be selected in consultation with EPA if necessary.

Sampling is anticipated to occur over a 10-day period, and no follow-up sampling events are planned as part of the natural attenuation evaluation. Any follow-up sampling needed to confirm the results of this evaluation may be conducted by FPD as part of the quarterly groundwater sampling activities and samples collected will be split with Tetra Tech if requested by EPA.

#### **1.5.3.5 Develop a Decision Rule**

The purpose of this step of the DQO determination process is to integrate previous DQO outputs into a single statement (decision rule) that describes a logical basis for choosing between alternative actions. EPA's MCLs represent groundwater contaminant concentrations above which risks to human health may occur. In addition, IAC standards for Class I aquifers propose groundwater contaminant concentrations above which groundwater contamination may pose a risk to human health. Therefore, the decision rule for the field investigation is "If the results of this natural attenuation evaluation indicate that target VOC concentrations may not be reduced by natural attenuation at the FPD property to below MCLs or IAC Class I aquifer criteria within a time period comparable to that of other remedial alternatives, an alternative remedial action may be recommended."

#### **1.5.3.6 Specify Limits on Decision Errors**

The sixth step of the DQO process defines tolerable limits on decision errors to establish performance goals for the data collection design. Potential sources of error are introduced during sample collection and analysis. Errors introduced during sample collection occur, for example, when the groundwater concentration of the sample does not represent the actual concentration of the contaminant in the aquifer at a given monitoring well location. Tetra Tech will attempt to reduce false-negative errors (that is, determination that contaminant concentrations are less than concentrations corresponding to acceptable risk levels when actual concentrations exceed these levels) by collecting biased samples near locations where previous RI sampling results indicate that groundwater contains contaminants at concentrations exceeding MCLs or IAC Class I groundwater criteria. This conservative approach may increase false-positive errors (that is, determination that contaminant concentrations are greater than MCLs or IAC Class I groundwater criteria when they are actually less); however, false-positive errors are acceptable because they are more protective of human health and the environment than false-negative errors.

Tetra Tech will reduce possible sample analytical error in two ways. First, Tetra Tech will obtain high-quality data by using a CLP laboratory for analysis of target and geochemical indicator analytes. Stringent QC requirements will ensure that CLP laboratories produce high-quality data with acceptable precision and accuracy limits. Second, Tetra Tech will review laboratory accuracy data to determine whether the reported sample concentrations are within the margin of analytical error. In some instances, laboratory data may not meet acceptance criteria for accuracy; if these criteria are not met for various samples, Tetra Tech will contact EPA concerning the need for corrective action. Corrective action may include resampling and reanalysis of the various matrices whose sampling results failed to meet acceptable accuracy criteria.

#### **1.5.3.7 Optimize the Design for Obtaining Data**

Based on the results of the first six steps of the DQO determination process, Tetra Tech has developed a sampling and analysis program that meets the overall project objectives as stated in Section 1.5 and the



project DQOs. The sampling approach and procedures are discussed in the FSP, which is Appendix B of the SAP.

## **1.6 SAMPLE NETWORK DESIGN AND RATIONALE**

The sample network design and rationale are described in detail in the FSP, which is Appendix B of the SAP. The sample network by task and matrix, site maps of sampling locations, and rationales for selecting sampling locations are described below.

### **1.6.1 Sample Network by Task and Matrix**

Sample matrices, analytical parameters, and frequencies of sample collection are summarized in Table B-5 of the FSP.

### **1.6.2 Site Maps of Sampling Locations**

Figure B-2 of the FSP shows intended leachate and groundwater sampling locations. Figure B-3 shows proposed soil sampling locations. It is possible, however, that depending on the nature of encountered field conditions, some of these locations will be changed. Surface water and sediment sampling locations will be determined in the field. The site manager and field sampling leader will be responsible for determining sampling locations in consultation with EPA.

### **1.6.3 Rationales for Selecting Sampling Locations**

The rationales for selecting sampling locations are summarized in Table B-4 of the FSP.

## **1.7 PROPOSED PROJECT SCHEDULE**

The proposed project schedule is described in detail in Section 7.0 of the FSP.

## **SECTION 2**

### **PROJECT ORGANIZATION AND RESPONSIBILITIES**

Under the direction of the EPA WA manager (WAM), Tetra Tech has overall responsibility for the sample collection and analysis, and field measurement activities necessary to assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell site and in evaluating the accuracy of analytical results of the laboratory used by FPD. Tetra Tech will also provide all project management. The project organization and responsibilities of various key management, QA, field, and laboratory personnel are discussed below. Support personnel roles are not discussed; however, all personnel will be required to adhere to all provisions of this QAPP.

#### **2.1 PROJECT ORGANIZATION**

The project organization is illustrated in Figure 2-1. Personnel responsibilities are discussed below.

#### **2.2 MANAGEMENT RESPONSIBILITIES**

The responsibilities of the EPA WAM, contractor (Tetra Tech) program manager, and Tetra Tech site manager are discussed below.

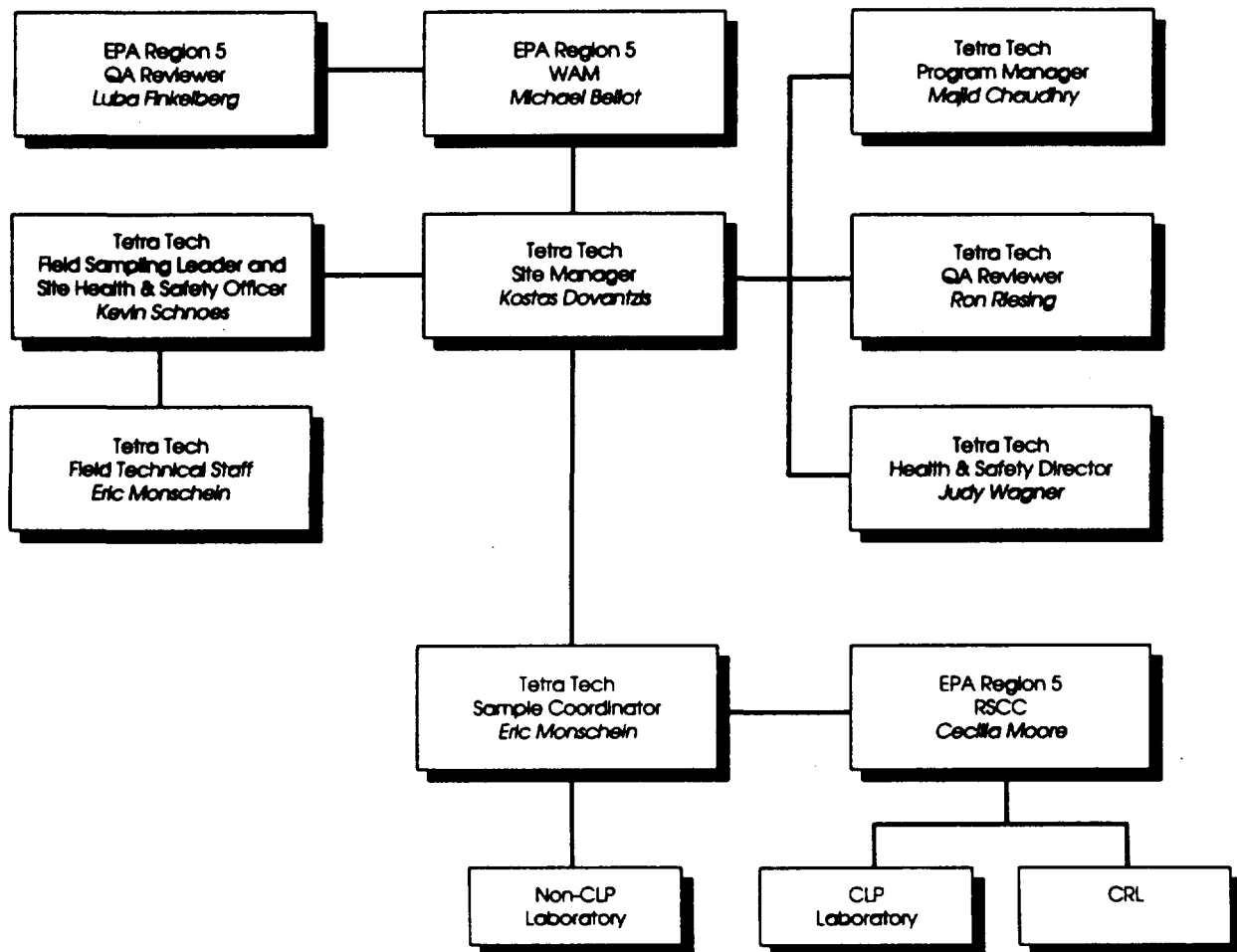
##### **EPA Work Assignment Manager**

The EPA WAM, Michael Bellot, has the overall responsibility for all phases of the field investigation, evaluation of natural attenuation, and for overseeing Tetra Tech's field activities.

##### **Tetra Tech Program Manager**

The Tetra Tech program manager, Majid Chaudhry, has overall responsibility for ensuring that the project meets EPA objectives and Tetra Tech quality standards. In addition, the program manager is responsible for technical quality control (QC) and project oversight and will provide the Tetra Tech site manager with access to corporate management.

**FIGURE 2-1**  
**PROJECT ORGANIZATION CHART**



Note:

RSCC = Regional sample control coordinator

### **Tetra Tech Site Manager**

The Tetra Tech site manager, Kostas Dovantzis, is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The site manager's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. The site manager will report directly to the EPA WAM and will provide the major point of contact and control for matters concerning the project. The site manager's duties and responsibilities are as follows:

- Define project objectives and develop a detailed work plan schedule
- Establish project policies and procedures to address specific needs of the project as a whole and objectives of each project task
- Acquire and apply technical and corporate resources as needed to ensure that project performance is within budget and schedule constraints
- Orient field sampling leader and technical staff concerning the project's special considerations
- Monitor and direct the field sampling leader
- Develop and meet ongoing project and task staffing requirements, including mechanisms to review and evaluate each task product
- Review the work performed under each task to ensure its quality, responsiveness, and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Approve all external reports (deliverables) before their submission to EPA Region 5
- Ultimately be responsible for the preparation and quality of interim and final reports
- Represent the project team at meetings and public hearings

## **2.3 QUALITY ASSURANCE RESPONSIBILITIES**

The responsibilities of the Tetra Tech QA reviewer and EPA QA reviewer are discussed below.

### **Tetra Tech Quality Assurance Reviewer**

The Tetra Tech QA reviewer, Ron Riesing, will remain independent of direct project involvement and day-to-day operations and will have direct access to corporate executive personnel as necessary to resolve any dispute. This individual is responsible for auditing the implementation of the QA program in conformance with Tetra Tech's Region 5 ARCS requirements, Tetra Tech policies, and EPA requirements. The Tetra Tech QA reviewer's specific functions and duties are as follows:

- Conduct audits of various phases of field operations
- Review and approve external reports (deliverables), including QAPPs, before their submission to EPA Region 5
- Provide QA technical assistance to project personnel
- Report on the adequacy, status, and effectiveness of the QA program on a regular basis to the Tetra Tech program manager and site manager

### **EPA Quality Assurance Reviewer**

The EPA QA reviewer, Luba Finkelberg, will review and approve all QAPPs. Additional responsibilities include the following:

- Schedule CLP analyses through the EPA Region 5 regional sample control coordinator (RSCC)
- Validate analytical data, including routine analytical services (RAS) and special analytical services (SAS) data and tentatively identified compounds data, through the EPA Region 5 Technical Support Section (TSS)
- Review and evaluate analytical field and laboratory procedures
- Conduct external performance and system audits of field activities

- Conduct performance and system audits of the CLP laboratories through EPA headquarters, EPA Region 5 TSS, the EPA Environmental Monitoring Systems Laboratory (EMSL) in Las Vegas, and the EPA Contract Laboratory Analytical Support Services
- Review and approve SAS requests and field and laboratory procedures in conjunction with the following:
  - EPA Region 5 TSS
  - EPA WAM
  - Tetra Tech QA reviewer

## **2.4 FIELD RESPONSIBILITIES**

The responsibilities of the Tetra Tech field sampling leader, health and safety director, site health and safety officer, and field technical staff are described below.

### **Tetra Tech Field Sampling Leader**

The Tetra Tech site manager will be supported by the Tetra Tech field sampling leader, Kevin Schnoes. The field sampling leader is responsible for leading and coordinating day-to-day field activities and reporting directly to the Tetra Tech site manager. Specific field sampling leader responsibilities are as follows:

- Provide day-to-day coordination with the site manager on technical issues in specific areas of expertise
- Develop and implement the FSP and ensure project schedule compliance
- Ensure that all Tetra Tech field personnel follow the site health and safety plan
- Coordinate and manage field personnel
- Implement QC procedures for technical data provided by field personnel, including field measurement data
- Identify problems at the field technical staff level and discuss resolutions with the site manager, implement and document corrective action procedures, and provide communication between the technical field staff and upper management

- Serve as liaison with the laboratory for scheduling laboratory space and receiving preliminary analytical results
- Participate in the preparation of the natural attenuation evaluation report

#### **Tetra Tech Health and Safety Director**

The health and safety director, Judy Wagner, will interact directly with the Tetra Tech site manager and will be responsible for providing technical coordination for the health and safety program. Additional health and safety director responsibilities are as follows:

- Act in an advisory capacity to the site health and safety officer
- Act as a liaison with officers and representatives of EPA on matters relating to health and safety
- Maintain up-to-date records of health and safety plan-related documentation and health and safety program participants

#### **Tetra Tech Site Health and Safety Officer**

The site health and safety officer, Kevin Schnoes, will report directly to the Tetra Tech site manager and will be responsible for the field implementation and enforcement of the health and safety plan. Additional site health and safety officer responsibilities are as follows:

- Ensure that the "Approval and Sign-Off Form" is signed by all personnel who are to perform field work
- Ensure that field personnel complete a "Daily Site Log" before leaving the site

#### **Tetra Tech Field Technical Staff**

The Tetra Tech field sampling leader will be supported by the Tetra Tech field technical staff. These field technical staff will have the following responsibilities:

- Conduct specific field investigation tasks outlined in the FSP
- Adhere to QAPP requirements
- Analyze data and prepare various task reports and support materials

## **2.5 LABORATORY RESPONSIBILITIES**

Laboratory analytical parameters will be analyzed using CLP and CRL RAS and SAS. Tetra Tech will schedule CLP and CRL analyses through the EPA RSCC. If scheduling conflicts arise, Tetra Tech will procure a non-CLP laboratory to conduct the sample analyses. The roles and responsibilities of the Tetra Tech sample coordinator, EPA RSCC, laboratory project manager, laboratory operations manager, laboratory QA officer, laboratory sample custodian, and laboratory technical personnel are described below. A list of matrix-specific parameters to be analyzed for by the CLP and CRL is presented in Table 1-1 of this QAPP.

Final responsibility for overall project quality rests with Tetra Tech's site manager. Independent QA will be provided by the laboratory project manager and QA officer prior to the release of all data to the EPA RSCC and Tetra Tech sample coordinator.

### **Tetra Tech Sample Coordinator**

The Tetra Tech sample coordinator, Eric Monschein, will report directly to the Tetra Tech site manager and will be responsible for coordinating laboratory analysis of field samples with the RSCC. The sample coordinator will have the following additional responsibilities:

- Ensure that chain-of-custody procedures are appropriately followed
- Coordinate receipt and management of laboratory analytical results



### **EPA Regional Sample Control Coordinator**

The EPA Region 5 RSCC, Cecilia Moore, will be responsible for scheduling RAS and SAS laboratory requests submitted by the Tetra Tech sample coordinator.

### **Laboratory Project Manager**

The CLP laboratory and CRL project manager will report directly to the EPA Region 5 RSCC and will have the following responsibilities:

- Ensure that all laboratory resources are available on an as-required basis
- Review final analytical reports

If the CRL does not have the adequate capacity or space to conduct the SAS analyses, Tetra Tech will procure another laboratory. The project manager from the procured laboratory will report directly to the Tetra Tech site manager and will have the same responsibilities as those stated above.

### **Laboratory Operations Manager**

The laboratory operations manager for each laboratory will report to the laboratory project manager and will have the following responsibilities:

- Coordinate laboratory analyses
- Supervise in-house chain-of-custody
- Schedule sample analyses
- Oversee data review
- Oversee preparation of analytical reports
- Approve final analytical reports prior to submission to RSCC and Tetra Tech

### **Laboratory Quality Assurance Officer**

The laboratory QA officer for each laboratory has the overall responsibility for data after they leave the laboratory. The laboratory QA officer will be independent of laboratory technical personnel involved with sample analysis but will communicate data issues to them through the laboratory project manager. In addition, the laboratory QA officer will have the following responsibilities:

- Oversee laboratory QA
- Oversee QA/QC documentation
- Conduct detailed data review
- Determine whether to implement laboratory corrective actions, if required
- Define appropriate laboratory QA procedures
- Prepare laboratory standard operating procedures (SOP)

### **Laboratory Sample Custodian**

The laboratory sample custodian for each laboratory will report to the laboratory operations manager. The laboratory sample custodian will have the following responsibilities:

- Receive and inspect incoming sample containers
- Record the condition of incoming sample containers
- Sign appropriate documents
- Verify that chain-of-custody records are complete and correctly recorded
- Notify the laboratory project manager of sample receipt and inspection
- Assign each sample a unique identification number and customer number, and enter each number into the sample receiving log
- Initiate transfer of samples to appropriate laboratory sections with the help of the laboratory project manager

- Control and monitor access and storage of samples and extracts

#### **Laboratory Technical Personnel**

Laboratory technical personnel from each laboratory will be responsible for sample analysis and identification of corrective action in accordance with the QAPP. These personnel will report directly to the laboratory operations manager.

### SECTION 3

#### QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objectives for measurement data are to develop and implement procedures for field sampling, sample chain-of-custody, laboratory analysis, and reporting that will provide valid and complete data required for the field investigation to assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell site. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, internal QC audits, data reporting, preventive maintenance for field equipment, data assessment, and corrective action are described in subsequent sections of this QAPP. This section discusses specific QA objectives for precision, accuracy, completeness, representativeness, comparability, level of QC effort, and project-required quantitation limits (PRQL).

#### 3.1 PRECISION

Precision is a measure of the degree to which two or more field or laboratory measurements are in agreement. The fundamental objectives with respect to field and laboratory precision are discussed below.

Precision in the field will be assessed by measuring field parameters in duplicate. Field instruments will be recalibrated until the relative percent difference (RPD) between duplicate samples is less than or equal to 10. Field measurement of conductivity, temperature, pH, dissolved oxygen, and ORP in leachate and groundwater will be conducted using an Aqua-Check Water Quality Analyzer, and CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> in soil gas will be measured in the field using a Landtec GA-90 Analyzer. Field measurement of ferrous iron will be conducted using a HACH DR/820 colorimeter and HACH Method 8146. Tetra Tech will follow the equipment manufacturer's instructions for performing these field measurements. The equipment manufacturer's instructions are presented in Attachment B of the FSP. Precision will be evaluated before sampling at each leachate and groundwater sampling location.

In addition, the field precision of leachate, groundwater, surface water, soil, and sediment samples will be assessed by collecting field duplicate samples for each matrix at a rate of 1 duplicate per every 10 or fewer samples to be analyzed at the CLP laboratory or CRL. The number of field duplicate samples to be collected during this field investigation is presented in Table B-6 of the FSP.

Precision for laboratory sample analysis will be assessed by determining the RPD of matrix spike (MS) and matrix spike duplicate (MSD) sample results (see Section 12). Precision requirements for RAS are presented in CLP SOWs. RAS requests for groundwater, surface water, soil, and sediment are specified in CLP SOW ILM04.0 (or its most recent version) for inorganics; RAS requests for the same matrices and leachate are specified in CLP SOWs OLM03.2 and OLC02.1 (or their most recent versions) for organics. Precision requirements for SAS are presented in the individual SAS requests presented in the attachment to this QAPP. SAS requests are only required for leachate and groundwater parameters and include EPA Method 310.1 for alkalinity; EPA Method 352.1 for nitrate; EPA Method 375.2 for sulfate; a laboratory SOP for CH<sub>4</sub>, ethane, and ethene; and EPA Method 325.1 or 325.2 for chloride. Precision for alkalinity, nitrate, sulfate, and chloride will be assessed by determining the RPD between laboratory duplicate samples. Precision for CH<sub>4</sub>, ethane, and ethene analysis will be assessed by determining the RPD of MS and MSD sample results.

### **3.2 ACCURACY**

Accuracy is the degree of agreement between an observed value and an accepted reference value. The fundamental objectives with regard to field and laboratory accuracy are discussed below.

Accuracy in the field will be assessed in accordance with the accuracy requirements outlined in the equipment manufacturer's instructions. Field measurement of conductivity, temperature, pH, dissolved oxygen, and ORP in leachate and groundwater will be conducted using an Aqua-Check Water Quality Analyzer, and CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> in soil gas will be measured in the field using a Landtec GA-90 Analyzer. Field measurement of ferrous iron will be conducted using a HACH DR/820 colorimeter and HACH Method 8146. Tetra Tech will follow the equipment manufacturer's instructions for performing these field measurements. The equipment manufacturer's instructions are presented in the Attachment B of the FSP.

In addition, the field accuracy of leachate, groundwater, surface water, soil, and sediment samples will be assessed through the use of equipment and trip blanks and through adherence to all sample handling, preservation, and holding times specified in the FSP.

Accuracy of laboratory sample analysis will be assessed by determining the percent recovery (%R) of MS and MSD samples (see Section 12). The MS/MSD leachate, groundwater, surface water, and soil samples will be collected and designated in the field for laboratory use to assess accuracy for this project. The accuracy requirements for RAS are specified in CLP SOW ILM04.0 (or its most recent version) for inorganics and in CLP SOWs OLM03.2 and OLC02.1 (or their most recent versions) for organics. Accuracy for SAS will be assessed by determining the %R for laboratory check standards. The accuracy requirements for SAS are specified in each individual SAS request contained in the attachment to this QAPP.

### **3.3 COMPLETENESS**

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. It is expected that field measurements will provide 90 percent or more data that meet the QC acceptance criteria and that the laboratories will provide 95 percent or more data that meet the QC acceptance criteria. If 90 percent of the field data and 95 percent of the laboratory data meet these criteria, the data sets are considered complete.

### **3.4 REPRESENTATIVENESS**

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter dependent on the proper design of the sampling program and proper laboratory protocols. The sample network for the field investigation was designed to provide data representative of site conditions. During development of the sample network, past waste disposal practices, existing analytical data, the physical site setting, and site processes were considered. A more detailed discussion of the sample network rationale is presented in the FSP. Representativeness of field data will be achieved by ensuring that the FSP is followed and that proper sampling techniques are used. Representativeness in the laboratory will be achieved by ensuring that proper laboratory analytical procedures are used and sample holding times are not exceeded.

### **3.5 COMPARABILITY**

Comparability expresses the confidence with which one data set can be compared to another.

Comparability is also dependent on similar QA objectives. Comparability of field data will be achieved by ensuring that the FSP is followed and that proper sampling techniques are used. Comparability of laboratory data will be achieved by ensuring that proper analytical procedures are followed.

### **3.6 LEVEL OF QUALITY CONTROL EFFORT**

QC samples, including duplicate samples, equipment blanks, trip blanks, and MS/MSD samples, will be collected during groundwater, leachate, surface water, soil, and sediment sampling and analyzed to assess data quality. The numbers of groundwater, leachate, surface water, soil, and sediment QC samples to be collected are listed in Table B-5 of the FSP.

Laboratory duplicate samples will be analyzed to check for sampling and analytical reproducibility. MS samples will be analyzed to provide information about the effect of the sample matrix on the digestion and measurement methodology. All MS samples will be analyzed in duplicate and are hereafter referred to as "MS/MSD" samples. Trip blanks will be analyzed to assess if samples were contaminated during shipment and storage. Equipment blanks will be analyzed to check for contamination resulting from decontamination and handling practices. The specific procedures to be used for collecting QC samples are described below.

#### **3.6.1 Duplicate Samples**

A duplicate sample consists of two separate samples collected from the same sampling location and depth using the same equipment and sampling procedures. Tetra Tech will collect 1 duplicate sample for every 10 or fewer matrix-specific samples collected. Duplicate samples will be collected using the same procedures used to collect investigative samples. Samples of the matrices to be split with FPD will be collected as duplicate samples but will be shipped to different laboratories. Analytical data for split samples from the EPA CLP laboratory will be used to assess the accuracy of the analytical results from FPD's laboratory.

### **3.6.2 Matrix Spike/Matrix Spike Duplicate Samples**

Of every 20 or fewer matrix-specific samples collected for laboratory analysis, 1 sample will be designated for MS/MSD analysis. MS/MSD samples will be collected using the same procedures used to collect investigative samples, except that they will be clearly designated for MS/MSD analysis. No extra volume is required for soil samples designated for MS/MSD analysis. The volume of groundwater, leachate, and surface water samples designated for MS/MSD VOC and SVOC analysis will be triple and double the normal volume collected for field samples, respectively.

### **3.6.3 Trip Blanks**

Trip blanks will be prepared for each cooler containing leachate, groundwater, surface water, and soil samples collected for VOC analysis. Trip blanks will consist of high-purity liquid chromatography water poured into sample bottles on the day of sampling. The trip blanks will be placed in the coolers and accompany the field team member to each sampling location. At the end of the day, trip blanks will be sealed into each cooler containing samples for VOC analysis.

### **3.6.4 Equipment Blanks**

Tetra Tech will collect 1 equipment blank for every 10 or fewer leachate, groundwater, soil, and sediment samples collected. Equipment blanks will consist of the final rinsate collected from decontaminated sampling equipment.

## **3.7 PROJECT-REQUIRED QUANTITATION LIMITS**

Laboratory and field screening PRQLs have been established for matrix-specific samples. Groundwater PRQLs for metals, VOCs, and SVOCs correspond to the chemical-specific MCL and State of Illinois potable resource groundwater criteria for Class I aquifers as presented in 35 IAC 620.410, whichever is lower. Table 3-1 presents the PRQLs for groundwater, as well as the analytical methods that will be used and their corresponding method detection limits. Geochemical indicator groundwater PRQLs correspond to the method detection limits specified in EPA Method 310.1 for alkalinity; EPA Method 352.1 for



TABLE 3-1

PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES

Page 1 of 6

Analyte	Project-Required Quantitation Limits <sup>a</sup>	Analytical Method	CRDL or CRQL (mg/L) <sup>b</sup>
<b>Metals</b>			
Aluminum	--	ILM04.0	0.2
Antimony	0.006	ILM04.0	0.06 <sup>f</sup>
Arsenic	0.05	ILM04.0	0.01
Barium	2	ILM04.0	0.2
Beryllium	0.004	ILM04.0	0.005 <sup>f</sup>
Cadmium	0.005	ILM04.0	0.005
Calcium	--	ILM04.0	5
Chromium (total)	0.1	ILM04.0	0.01
Cobalt	1 <sup>c</sup>	ILM04.0	0.05
Copper	0.65 <sup>d</sup>	ILM04.0	0.025
Iron	4.0 <sup>c</sup>	ILM04.0	0.1
Lead	0.0075 <sup>d</sup>	ILM04.0	0.003
Magnesium	--	ILM04.0	5
Manganese	0.15 <sup>d</sup>	ILM04.0	0.015
Mercury	0.002	ILM04.0	0.0002
Nickel	0.1	ILM04.0	0.04
Potassium	--	ILM04.0	5
Selenium	0.05	ILM04.0	0.005
Silver	0.05 <sup>d</sup>	ILM04.0	0.01
Sodium	--	ILM04.0	5
Thallium	0.002	ILM04.0	0.01 <sup>f</sup>
Vanadium	--	ILM04.0	0.05
Zinc	5 <sup>d</sup>	ILM04.0	0.02

**TABLE 3-1**  
**PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES**

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Analyte	Project-Required Quantitation Limits <sup>a</sup>	Analytical Method	CRDL or CRQL (mg/L) <sup>b</sup>
<b>Volatile Organic Compounds</b>			
Chloromethane	--	OLC02.1	0.001
Bromomethane	--	OLC02.1	0.001
Vinyl chloride	0.002	OLC02.1	0.001
Chloroethane	--	OLC02.1	0.001
Methylene chloride	0.005	OLC02.1	0.002
Acetone	--	OLC02.1	0.005
Carbon disulfide	--	OLC02.1	0.001
1,1-Dichloroethene	0.007	OLC02.1	0.001
1,1-Dichloroethane	--	OLC02.1	0.001
1,2-Dichloroethene (total)	0.007	OLC02.1	0.001
Chloroform	0.1	OLC02.1	0.001
1,2-Dichloroethane	0.005	OLC02.1	0.001
2-Butanone	--	OLC02.1	0.005
Bromochloromethane	--	OLC02.1	0.001
1,1,1-Trichloroethane	0.2	OLC02.1	0.001
Carbon tetrachloride	0.005	OLC02.1	0.001
Bromodichloromethane	0.1	OLC02.1	0.001
1,2-Dichloropropane	0.005	OLC02.1	0.001
cis-1,3-Dichloropropene	--	OLC02.1	0.001
Trichloroethene	0.005	OLC02.1	0.001
Dibromochloromethane	0.1	OLC02.1	0.001
1,1,2-Trichloroethane	0.005	OLC02.1	0.001
Benzene	0.005	OLC02.1	0.001
trans-1,3-Dichloropropene	--	OLC02.1	0.001
Bromoform	0.1	OLC02.1	0.001
4-Methyl-2-pentanone	--	OLC02.1	0.001
2-Hexanone	--	OLC02.1	0.005
Tetrachloroethene	0.005	OLC02.1	0.005

TABLE 3-1

PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES

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Analyte	Project-Required Quantitation Limits <sup>a</sup>	Analytical Method	CRDL or CRQL (mg/L) <sup>b</sup>
<b>Volatile Organic Compounds (Continued)</b>			
1,1,2,2-Tetrachloroethane	--	OLC02.1	0.001
1,2-Dibromoethane	--	OLC02.1	0.001
Toluene	1	OLC02.1	0.001
Chlorobenzene	--	OLC02.1	0.001
Ethylbenzene	0.7	OLC02.1	0.001
Styrene	0.1	OLC02.1	0.001
Xylenes (total)	10	OLC02.1	0.001
1,3-Dichlorobenzene	--	OLC02.1	0.001
1,4-Dichlorobenzene	0.075	OLC02.1	0.001
1,2-Dichlorobenzene	0.6	OLC02.1	0.001
1,2-Dibromo-3-chloropropane	0.0002	OLC02.1	0.001 <sup>c</sup>
1,2,4-Trichlorobenzene	0.07	OLC02.1	0.001
<b>Semivolatile Organic Compounds</b>			
Phenol	0.1 <sup>c</sup>	OLC02.1	0.005
bis-(2-Chloroethyl)ether	--	OLC02.1	0.005
2-Chlorophenol	--	OLC02.1	0.005
2-Methylphenol	--	OLC02.1	0.005
2,2'-oxybis (1-Chloropropane)	--	OLC02.1	0.005
4-Methylphenol	--	OLC02.1	0.005
n-Nitroso-di-n-propylamine	--	OLC02.1	0.005
Hexachloroethane	--	OLC02.1	0.005
Nitrobenzene	--	OLC02.1	0.005
Isophorone	--	OLC02.1	0.005
2-Nitrophenol	--	OLC02.1	0.005
2,4-Dimethylphenol	--	OLC02.1	0.005
bis(2-Chloroethoxy)methane	--	OLC02.1	0.005
2,4-Dichlorophenol	--	OLC02.1	0.005
Naphthalene	--	OLC02.1	0.005

**TABLE 3-1**  
**PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES**

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Analyte	Project-Required Quantitation Limits <sup>a</sup>	Analytical Method	CRDL or CRQL (mg/L) <sup>b</sup>
<b>Semivolatile Organic Compounds (Continued)</b>			
4-Chloroaniline	--	OLC02.1	0.005
Hexachlorobutadiene	0.05 <sup>c</sup>	OLC02.1	0.005
4-Chloro-3-methylphenol	--	OLC02.1	0.005
2-Methylnaphthalene	--	OLC02.1	0.005
Hexachlorocyclopentadiene	0.05	OLC02.1	0.005
2,4,6-Trichlorophenol	--	OLC02.1	0.005
2,4,5-Trichlorophenol	--	OLC02.1	0.02
2-Chloronaphthalene	--	OLC02.1	0.005
2-Nitroaniline	--	OLC02.1	0.02
Dimethylphthalate	--	OLC02.1	0.005
Acenaphthylene	--	OLC02.1	0.005
2,6-Dinitrotoluene	--	OLC02.1	0.005
3-Nitroaniline	--	OLC02.1	0.02
Acenaphthene	--	OLC02.1	0.005
2,4-Dinitrophenol	--	OLC02.1	0.02
4-Nitrophenol	--	OLC02.1	0.02
Dibenzofuran	--	OLC02.1	0.005
2,4-Dinitrotoluene	--	OLC02.1	0.005
Diethylphthalate	--	OLC02.1	0.005
4-Chlorophenyl-phenyl ether	--	OLC02.1	0.005
Fluorene	--	OLC02.1	0.005
4-Nitroaniline	--	OLC02.1	0.02
4,6-Dinitro-2-methylphenol	--	OLC02.1	0.02
N-Nitroso-diphenylamine	--	OLC02.1	0.005
4-Bromophenylphenylether	--	OLC02.1	0.005
Hexachlorobenzene	0.001	OLC02.1	0.005 <sup>c</sup>
Pentachlorophenol	0.001	OLC02.1	0.02 <sup>c</sup>
Phenanthrene	--	OLC02.1	0.005

TABLE 3-1

PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES

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Analyte	Project-Required Quantitation Limits <sup>a</sup>	Analytical Method	CRDL or CRQL (mg/L) <sup>b</sup>
<b>Semivolatile Organic Compounds (Continued)</b>			
Anthracene	--	OLC02.1	0.005
di-n-Butylphthalate	--	OLC02.1	0.005
Fluoranthene	--	OLC02.1	0.005
Pyrene	--	OLC02.1	0.005
Butylbenzylphthalate	--	OLC02.1	0.005
3,3'-Dichlorobenzidine	--	OLC02.1	0.005
Benzo(a)anthracene	--	OLC02.1	0.005
Chrysene	--	OLC02.1	0.005
bis(2-Ethylhexyl)phthalate	--	OLC02.1	0.005
di-n-octylphthalate	--	OLC02.1	0.005
Benzo(b)fluoranthene	--	OLC02.1	0.005
Benzo(k)fluoranthene	--	OLC02.1	0.005
Benzo(a)pyrene	0.0002	OLC02.1	0.005 <sup>c</sup>
Indeno(1,2,3-cd)pyrene	--	OLC02.1	0.005
Dibenzo(a,h)anthracene	--	OLC02.1	0.005
Benzo(g,h,i)perylene	--	OLC02.1	0.005

Notes:

- CRDL = Contract-required detection limit  
CRQL = Contract-required quantitation limit  
IAC = Illinois Administrative Code  
mg/L = Milligram per liter  
PRQL = Project-required quantitation limit  
-- = PRQL coincides with applicable CRDL or CRQL because no MCL or IAC Class I criteria exists for this contaminant

<sup>a</sup> To establish PRQLs, Tetra Tech evaluated MCLs (EPA 1996b) and IAC Class I groundwater criteria. Unless otherwise noted, MCLs and IAC Class I criteria are identical and are used as the PRQLs.

<sup>b</sup> CRQLs are listed in CLP SOW OLC02.1 (or its most current version) for organics, and CRDLs are listed in CLP SOW ILM04.0 (or its most current version) for inorganics.

**TABLE 3-1**

**PROJECT-REQUIRED QUANTITATION LIMITS FOR GROUNDWATER SAMPLES**

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- c The MCL for this contaminant is not established. The IAC Class I criteria is used as the PRQL.
- d The MCL exceeds the IAC Class I criteria which is used as the PRQL.
- e Although the chemical-specific CRQL is above the PRQL, the CRQL is considered adequate because of this chemical's nondetect status during the RI (Warzyn 1994).
- f Although the chemical-specific CRDL is above the PRQL, the CRDL is considered adequate because the analytical data from the metals analysis will not be used to evaluate natural attenuation.

nitrate; EPA Method 375.2 for sulfate; a laboratory standard operating procedure for CH<sub>4</sub>, ethane, and ethene; and EPA Method 325.1 or 325.2 for chloride. For analyzing CH<sub>4</sub>, ethane, and ethene in groundwater and leachate, the PRQLs will be equal to the laboratory reporting limits which should be less than or equal to 0.5 micrograms per liter for all three compounds.

Leachate and surface water PRQLs are the contract-required quantitation limits (CRQL) and contract-required detection limits (CRDL) specified in CLP SOWs OLM03.2 and ILM04.0 (or their most current versions) for analysis of organics and metals, respectively. Geochemical indicator parameter leachate PRQLs correspond to the method detection limits specified in EPA Method 310.1 for alkalinity; EPA Method 352.1 for nitrate; EPA Method 375.2 for sulfate; a laboratory standard operating procedure for CH<sub>4</sub>, ethane, and ethene; and EPA Method 325.1 or 325.2 for chloride.

Soil and sediment PRQLs are the CRQLs and CRDLs specified in CLP SOWs OLM03.2 (for low concentration samples) and ILM04.0 (or their most current versions) for analysis of organics and metals, respectively. The PRQLs for soil and sediment samples to be analyzed by the FPD are not established in the predesign QAPP (MW 1996). Analytical methods and PRQLs for samples to be split between EPA and FPD should be comparable.

Quantitation limits for field screening of conductivity, temperature, pH, dissolved oxygen, ORP, and ferrous iron for leachate and groundwater and CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> for soil gas are discussed in the applicable equipment manufacturer's literature presented in Attachment B of the FSP.

## **SECTION 4**

### **SAMPLING PROCEDURES**

Sampling procedures are described in the FSP. Sections of the FSP that discuss sampling equipment, sample collection procedures, QC samples, order of sample fraction collection, sample containers, decontamination procedures, ancillary field procedures, and sample packaging and shipping are specified below.

#### **Sampling Equipment**

Sampling equipment required for field measurements and sample collection of leachate, groundwater, and soil gas is discussed in Section 4.0 of the FSP. Because Tetra Tech will be obtaining split samples of soil, surface water, and sediment from the FPD, sampling equipment is not required for these matrices.

#### **Sample Collection Procedures**

Sample collection procedures for field measurements and leachate, groundwater, and soil gas sampling are discussed in Section 4.0 of the FSP. Because Tetra Tech will be obtaining split samples of soil, surface water, and sediment from the FPD, sample collection procedures are not required for these matrices.

#### **Quality Control Samples**

The number of QC samples, including field duplicates, equipment blanks, trip blanks, and MS/MSDs, are described in Section 3.6 of this QAPP.

#### **Order of Sample Fraction Collection**

The order of sample fraction collection for leachate, groundwater, and soil gas is discussed in Section 4.1 of the FSP. Because Tetra Tech will be obtaining split samples of soil, surface water, and sediment from the FPD, the order of sample fraction collection will be as specified in FPD's approved sampling plan.



### **Sample Containers**

Specifications for obtaining contaminant-free sample containers and information regarding the types, number, and volumes of containers required for the field investigation are described in Section 6.1 of the FSP. Sample preservation and preparation requirements are described in Section 6.2 of the FSP.

### **Decontamination Procedures**

Decontamination procedures for sampling equipment are discussed in Section 5.0 of the FSP.

### **Ancillary Field Procedures**

No ancillary field procedures will be performed.

### **Sample Packaging and Shipping**

Sample packaging and shipping procedures are discussed in Section 6.5 of the FSP.

## **SECTION 5**

### **CUSTODY PROCEDURES**

Proper chain-of-custody for samples is necessary for the admissibility of environmental data as evidence in a court of law. A sample or evidence file is considered under an individual's custody if any of the following conditions are met:

- The item is in the actual possession of the individual.
- The item is in the view of the individual after being in actual possession of the individual.
- The item was in the actual physical possession of an individual but is locked up to prevent tampering.
- The item is in a designated and identified secure area.

All chain-of-custody procedures will conform with the EPA Region 5 sample custody and chain-of-custody protocols described in "National Enforcement Investigation Center (NEIC) Policies and Procedures" (EPA 1985). This document divides chain-of-custody procedures into three categories: sample collection, laboratory analysis, and final evidence file. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area. Field chain-of-custody, laboratory chain-of-custody, and final evidence file chain-of-custody procedures are discussed below.

#### **5.1 FIELD CHAIN-OF-CUSTODY PROCEDURES**

Sample packaging and shipment procedures will help ensure that samples are shipped in accordance with all EPA-mandated chain-of-custody procedures. Protocols for specific sample numbering designations are discussed in the FSP. Field procedures, field logbooks and documentation, and transfer of custody and shipment procedures to maintain field chain-of-custody requirements are discussed below.

### **5.1.1 Field Procedures**

The following procedures must be followed to maintain chain-of-custody during sample collection in the field:

- The Tetra Tech field sampling leader is personally responsible for the care and custody of the samples until they are transferred or properly dispatched to the laboratory. As few people as possible will handle the samples.
- All bottles will be tagged with sample numbers and sampling location designations. Sample tags and labels must be affixed to each bottle shipped to the laboratory. QC samples, which receive an entirely separate sample identification number, will be noted under the sample description.
- Sample tags must be completed for each sample using waterproof ink unless prohibited by weather conditions. If waterproof ink is not used, a logbook notation should explain why. For example, the logbook could explain that a pencil was used to fill out the sample tag because the ballpoint pen would not function in freezing weather.
- Prior to shipping, the chain-of-custody forms, air bills, and all other relevant documents will be completed. Chain-of-custody forms will be sealed in plastic bags and taped to the inside of the cooler lid. An insert absorbent material (vermiculite) will also be placed in the cooler for cushioning.

### **5.1.2 Field Logbooks and Documentation**

Field logbooks are used to record field activities. Logbook entries will describe field activities in as much detail as possible. Field logbooks are bound, field survey books or notebooks assigned to field personnel and stored in Tetra Tech's Chicago office document control room when not in use. Each logbook will be identified by a project-specific document number. The title page of each logbook will contain the following information:

- Person to whom the logbook is assigned
- Logbook number
- Project name
- Project start date

- Project end date

Logbook entries contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection used, and signature of the person making the entry will be entered. The names of visitors to the site, names of field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out using a single strike mark. Whenever a sample is collected or a measurement is made, the time of sampling will be noted, along with a sample description, depth from which the sample was collected, and volume and number of containers used to hold the sample. The number of photographs taken of each sampling location, if any, will also be noted. All equipment used to take measurements will be identified, along with the date of calibration.

### **5.1.3 Transfer of Custody and Shipment Procedures**

Sample chain-of-custody procedures and paperwork requirements for all samples are described in the FSP. EPA-mandated procedures for the transfer of sample custody are summarized below.

- Samples must be accompanied by a properly completed chain-of-custody form. The sample numbers and location designations must be listed on the chain-of-custody form. When transferring possession of samples, the individuals relinquishing and receiving the samples must sign, date, and note the time of transfer on the chain-of-custody record. This record documents the custody transfer of samples from the sampler to another party (for example, to a mobile laboratory, to the permanent laboratory, or to or from a secure storage area).
- Samples must be properly packaged on ice at 4 °C for shipment and dispatched to the appropriate laboratory for analysis with a signed custody record enclosed in each sample box or cooler. Shipping containers must be locked or secured with strapping tape. EPA custody seals must be used to seal each sample box or cooler for shipment to the laboratory. The preferred procedure includes attaching a custody seal to the front right or left side of the cooler and attaching the other seal on the back side of the cooler on the opposite corner or center of the cooler. Custody seals must be covered with clear plastic tape. The cooler must be strapped shut with strapping tape in at least two locations.

- All shipments must be accompanied by a chain-of-custody record identifying the contents. Colored copies of the chain-of-custody record will be delivered to the appropriate entities as required by the chain-of-custody form.
- If the samples are sent by common carrier, a bill of lading will be used. Receipts of bills of lading must be retained as part of the permanent documentation. If sent by mail, the sample package must be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.
- Samples will be shipped to the laboratory by overnight carrier within 2 days of collection.

Sections 6.4 and 6.5 of the FSP and Tetra Tech SOPs No. 018 and 019 in Attachment A of the FSP provide additional information concerning custody and shipment procedures.

## **5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES**

Field investigation samples will be analyzed by either a CLP laboratory, EPA Region 5 CRL, or a non-CLP laboratory procured by Tetra Tech if scheduling conflicts arise. Chain-of-custody procedures for CLP laboratories are described in CLP SOWs OLM03.2 and OCL02.1 (or their most current versions) for VOC and SVOC analyses, and CLP SOW ILM04.0 (or its most current version) for inorganic analyses. Chain-of-custody procedures for samples shipped to the CRL are described in the CRL's SOPs. If sample analysis scheduling conflicts arise with EPA, the chain-of-custody procedures outlined in the non-CLP laboratory's SOPs will be followed.

## **5.3 FINAL EVIDENCE FILE CHAIN-OF-CUSTODY PROCEDURES**

Tetra Tech is the custodian of the evidence file and will maintain the contents of the evidence files for this field investigation, including all relevant records, reports, field logbooks, field notebooks, documents, photographs, drawings, field and data deliverables, correspondence, laboratory data, chain-of-custody documents, and TSS data reviews. All evidence files will be kept in a secured, limited access area under custody of the Tetra Tech site manager. The final evidence file will be submitted to EPA with all other project files when Tetra Tech receives notification from EPA to close out the WA.

## **SECTION 6**

### **CALIBRATION PROCEDURES AND FREQUENCIES**

This section discusses the calibration procedures and frequencies used to maintain the accuracy of all field testing and laboratory analytical equipment. These instruments and equipment will be calibrated prior to each use or on a scheduled, periodic basis. Calibration procedures and frequencies for field instruments and laboratory instruments are discussed below.

#### **6.1 CALIBRATION OF FIELD INSTRUMENTS**

Calibration of field instruments will be conducted in accordance with the equipment manufacturer instructions presented in Attachment B of the FSP. Field instruments include an Aqua-Check Water Quality Analyzer for measurement of pH, temperature, conductivity, dissolved oxygen, and ORP in groundwater and leachate; a Landtec GA-90 Analyzer for measurement of CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> in soil gas; and a HACH DR/820 colorimeter for measurement of ferrous iron in groundwater and leachate.

#### **6.2 CALIBRATION OF LABORATORY INSTRUMENTS**

Except for parameters that will be analyzed in accordance with the SAS requests in the attachment to this QAPP, target contaminants will be analyzed for using procedures presented in the CLP organic and inorganic SOWs. Laboratory calibration procedures and frequencies are specified in the SOWs.

Laboratory calibration procedures and frequencies for alkalinity; nitrate; sulfate; chloride; and CH<sub>4</sub>, ethane, and ethene, which will be analyzed for in accordance with the SAS requests, are summarized in Table 6-1.

Specific calibration procedures are presented in the referenced analytical methods in Table 6-1.

**TABLE 6-1**  
**SUMMARY OF SAS REQUEST INSTRUMENT CALIBRATION REQUIREMENTS**

Page 1 of 2

Analyte	Analytical Method	QC Check	Frequency	Acceptance Criterion	Corrective Action(s)
Alkalinity	EPA Method 310.1	Standardize titrant	As detailed in Section 4.1 of Method 310.1	As detailed in section 4.1 of Method 310.1	Repeat standardization
		pH meter or titrator calibration	As detailed in Section 4.1 of Method 310.1	As detailed in section 4.1 of Method 310.1	Repeat calibration
Nitrate	EPA Method 352.1	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At the beginning and end of analysis of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard 3. Repeat initial calibration
Sulfate	EPA Method 375.2	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At the beginning and end of analysis of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard 3. Repeat initial calibration

TABLE 6-1

SUMMARY OF SAS REQUESTS INSTRUMENT CALIBRATION REQUIREMENTS

Page 2 of 2

Analyte	Analytical Method	QC Check	Frequency	Acceptance Criterion	Corrective Action(s)
Chloride	EPA Method 325.1 or 325.2	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At the beginning and end of analysis of each sample batch	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard. 3. Repeat initial calibration
CH <sub>4</sub> , Ethane, and Ethene	Laboratory Standard Operating Procedure	Initial calibration	Before sample analysis	$r^2 \geq 0.995$	1. Check calculations 2. Rerun one point on the calibration curve 3. If $r^2$ is still less than 0.995, rerun entire calibration curve
		Continuing calibration	One per 20 or fewer samples per matrix and at the end of an analytical batch	Instrument response within 15 percent of calibration standard value	1. Check calculations 2. Reanalyze with a fresh standard 3. Repeat initial calibration 4. Reanalyze samples analyzed since last failed calibration check

Notes:

CH<sub>4</sub> = Methane  
QC = Quality control  
 $r^2$  = Correlation coefficient for multipoint calibration



## **SECTION 7**

### **ANALYTICAL PROCEDURES**

Groundwater, leachate, surface water, soil, and sediment samples will be analyzed by a CLP laboratory and the CRL using RAS and SAS procedures. Field screening analytical protocols and laboratory analytical protocols are discussed below.

#### **7.1 FIELD SCREENING ANALYTICAL PROTOCOLS**

Field measurements include measurement of conductivity, dissolved oxygen, temperature, pH, and ORP in groundwater and leachate using an Aqua-Check Water Quality Analyzer; measurement of CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub> in soil gas using a Landtec GA-90 Analyzer; and measurement of ferrous iron in groundwater and leachate using a HACH DR/820 colorimeter. Tetra Tech will perform these measurements in accordance with the manufacturer's instructions provided in Attachment B of the FSP. Table 7-1 summarizes matrix-specific parameters for field screening and the methods of analysis.

#### **7.2 LABORATORY ANALYTICAL PROTOCOLS**

Metals, VOCs, and SVOCs in groundwater, surface water, soil, and sediment samples, and VOCs and SVOCs in leachate samples, will be analyzed by a CLP laboratory as specified in CLP SOW OLM03.2 and OLC02.1 (or their most current versions) for organics and the CLP SOW ILM04.0 (or its most current version) for inorganics.

SAS requests will be conducted by the CRL, or a non-CLP laboratory to be procured by Tetra Tech if the CRL does not have adequate capacity or space, according to the SAS request forms in Attachment A of this QAPP. SAS requests specify calibration procedures, frequencies of calibration, and internal QC checks required for each analysis. SAS requests include analysis of groundwater and leachate samples for alkalinity; nitrate; sulfate; chloride; and CH<sub>4</sub>, ethane, and ethene. Table 7-1 presents the matrix and parameters to be analyzed for, as well as the analytical methods and laboratories that will be used.

**TABLE 7-1**  
**MATRICES, PARAMETERS, ANALYTICAL METHODS, AND LABORATORIES**  
Page 1 of 3

Parameter	Analyte	Analytical Method	Laboratory
<b>Groundwater</b>			
Target <sup>a</sup>	Metals <sup>b</sup>	CLP SOW ILM04.0	CLP
	VOCs and SVOCs <sup>c</sup>	CLP SOW OLC02.1	CLP
Geochemical Indicator	Conductivity	Aqua-Check Water Quality Analyzer	Field
	Dissolved Oxygen	Aqua-Check Water Quality Analyzer	Field
	Temperature	Aqua-Check Water Quality Analyzer	Field
	pH	Aqua-Check Water Quality Analyzer	Field
	ORP	Aqua-Check Water Quality Analyzer	Field
	Ferrous Iron	Colorimetric HACH Method 8146 <sup>d</sup>	Field
	Alkalinity	EPA Method 310.1	CRL
	Nitrate	EPA Method 352.1 <sup>e</sup>	CRL
	Sulfate	EPA Method 375.2 <sup>e</sup>	CRL
	Chloride	EPA Method 325.1 or 325.2 <sup>e</sup>	CRL
	CH <sub>4</sub> , ethane, and ethene	Laboratory SOP <sup>f</sup>	CRL
<b>Leachate</b>			
Target	VOCs and SVOCs <sup>g</sup>	CLP SOW OLM03.2	CLP
Geochemical Indicator	Conductivity	Aqua-Check Water Quality Analyzer	Field
	Dissolved oxygen	Aqua-Check Water Quality Analyzer	Field
	Temperature	Aqua-Check Water Quality Analyzer	Field
	pH	Aqua-Check Water Quality Analyzer	Field
	ORP	Aqua-Check Water Quality Analyzer	Field
	Ferrous iron	Colorimetric HACH Method 8146 <sup>d</sup>	Field
	Alkalinity	EPA Method 310.1 <sup>e</sup>	CRL
	Nitrate	EPA Method 352.1 <sup>e</sup>	CRL
	Sulfate	EPA Method 375.2 <sup>e</sup>	CRL

**TABLE 7-1**  
**MATRICES, PARAMETERS, ANALYTICAL METHODS, AND LABORATORIES**

Page 2 of 3

Parameter	Analyte	Analytical Method	Laboratory
Geotechnical Indicator (Continued)	Chloride	EPA Method 325.1 or 325.2 <sup>c</sup>	CRL
	CH <sub>4</sub> , ethane, and ethene	Laboratory SOP <sup>d</sup>	CRL
<b>Soil Gas</b>			
Geochemical Indicator	CH <sub>4</sub> , CO <sub>2</sub> , and O <sub>2</sub>	Landtec GA-90 Analyzer	Field
<b>Surface Water</b>			
Target	Metals <sup>b</sup>	CLP SOW ILM04.0	CLP
	VOCs and SVOCs <sup>a</sup>	CLP SOW OLM03.2	CLP
<b>Soil and Sediment</b>			
Target	Metals <sup>b</sup>	CLP SOW ILM04.0	CLP
	VOCs and SVOCs <sup>a</sup>	CLP SOW OLM03.2 (low level)	CLP

Notes:

ASTM = American Society for Testing and Materials  
CH<sub>4</sub> = Methane  
CLP = Contract Laboratory Program  
CRL = Central Regional Laboratory  
CO<sub>2</sub> = Carbon dioxide  
EPA = U.S. Environmental Protection Agency

O<sub>2</sub> = Oxygen  
ORP = Oxidation-reduction potential  
SOP = Standard operating procedure  
SOW = Statement of work  
SVOC = Semivolatile organic compound  
VOC = Volatile organic compound

- <sup>a</sup> All groundwater samples collected by Tetra Tech will be analyzed for VOCs and SVOCs. Four of these samples will be analyzed for metals. If FPD collects groundwater and leachate samples for evaluating natural attenuation, Tetra Tech will obtain four groundwater split samples and analyze them for VOCs, SVOCs, and metals.
- <sup>b</sup> Target analytes for groundwater and surface water samples are listed in the CLP SOW ILM04.0 (or its most current version) for metals.
- <sup>c</sup> Target analytes are listed in the CLP SOW OLC02.1 (or its most current version) for VOCs and SVOCs.
- <sup>d</sup> "HACH" refers to the Hach Company.
- <sup>e</sup> Source: EPA 1983

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**TABLE 7-1**

**MATRICES, PARAMETERS, ANALYTICAL METHODS, AND LABORATORIES**

Page 3 of 3

Notes: (Continued)

The laboratory SOP should be used for analysis of aqueous samples for CH<sub>4</sub>, ethane, and ethene. The laboratory SOP should be based on the headspace sample preparation method SW-846 Method 3810, followed by the gas chromatographic determinative method ASTM Method D3416. The laboratory reporting limit for analyzing CH<sub>4</sub>, ethane, and ethene in groundwater and leachate should be less than or equal to 0.5 micrograms per liter for each of the three compounds.

Target analytes are listed in the CLP SOW OLM03.2 (or its most current version) for VOCs and SVOCs.

The EPA-approved methods presented in Table 7-1 are described in the most recent CLP SOWs and in *Methods for Chemical Analysis of Water and Wastes* (EPA 1983). A laboratory SOP will be used to analyze groundwater and leachate samples for CH<sub>4</sub>, ethane, and ethene. The laboratory SOP should be based on the headspace sample preparation method SW-846 Method 3810, followed by the gas chromatographic determinative method, American Society for Testing and Materials (ASTM) Method D 3416. The laboratory reporting limit for CH<sub>4</sub>, ethane, and ethene in groundwater and leachate samples should be less than or equal to 0.5 micrograms per liter for each of the three compounds.

PRQLs for target and geochemical indicator analytes are described in Section 3 of this QAPP. Section 8 of this QAPP describes the associated QC samples for each matrix-specific parameter.

## **SECTION 8**

### **INTERNAL QUALITY CONTROL CHECKS**

QC will be performed for both field measurements and laboratory analyses. Internal field QC and laboratory checks are discussed below.

#### **8.1 FIELD QUALITY CONTROL CHECKS**

QC procedures for field measurements of pH; conductivity; temperature; dissolved oxygen; ORP; CH<sub>4</sub>, CO<sub>2</sub>, and O<sub>2</sub>; and ferrous iron are limited to checking the reproducibility of the measurements by obtaining multiple readings from a single sample or standard and by calibrating the instruments. Calibration and operation procedures are discussed in detail in the manufacturer's literature presented in Attachment B of the FSP.

Field sampling precision and accuracy will be assessed by collecting field duplicates and field blanks in accordance with applicable procedures and frequencies indicated in the FSP.

#### **8.2 LABORATORY QUALITY CONTROL CHECKS**

All analyses of VOCs, SVOCs, and metals will be conducted using procedures presented in the CLP organic and inorganic SOWs. Internal QC procedures are specified in the latest SOWs for organic and inorganic analyses. These specifications include the types of QC checks required, such as method blanks, reagent/preparation blanks, MS/MSDs, calibration standards, internal standards, surrogate standards, the frequency of each audit, specific calibration check standards, and laboratory duplicate and replicate analyses. The specifications also include compounds and concentrations to be used for the QC checks and the QC acceptance criteria for these audits. Stock solutions for the laboratory check standards should be prepared from batches other than those used for instrument calibration. Stock solutions should include potassium nitrate for alkalinity; potassium nitrate for nitrate; sodium sulfate for sulfate; sodium chloride for chloride; and 1% gas standard of CH<sub>4</sub>, ethane, and ethene in nitrogen or helium for CH<sub>4</sub>, ethane, and ethene analysis.

Alkalinity; nitrate; sulfate; chloride; and CH<sub>4</sub>, ethane, and ethene, will be analyzed in accordance with the SAS request forms in the attachment to this QAPP. Table 8-1 summarizes internal QC procedures for the SAS request analytes. Calibration requirements are summarized in Table 6-1. These tables also present corrective actions required if QC criteria are exceeded. If the data needs to be flagged during corrective actions, the laboratory will prepare a nonconformance memorandum that documents the nonconformance and its cause. In addition, QC checks for SAS request analytes are identified in the QC requirements sections of the SAS requests.

**TABLE 8-1**  
**SUMMARY OF CLP SAS REQUEST INTERNAL QC PROCEDURES**  
Page 1 of 3

Analyte	Analytical Method	QC Check	Frequency	Acceptance Criterion	Corrective Actions
Alkalinity	EPA Method 310.1	Laboratory duplicate	1 per 20 samples or per analytical batch, whichever is more frequent	$RPD \leq 10\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS	1 per 20 samples or per analytical batch, whichever is more frequent	$\pm 10$ percent of standard value	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
Nitrate	EPA Method 352.1	Method blank	One per analytical batch	$\leq 0.1$ mg/L	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	1 per 20 samples or per analytical batch, whichever is more frequent	$RPD \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS	1 per 20 samples or per analytical batch, whichever is more frequent	80 to 120%R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data



**TABLE 8-1**  
**SUMMARY OF CLP SAS REQUEST INTERNAL QC PROCEDURES**

Page 2 of 3

Analyte	Analytical Method	QC Check	Frequency	Acceptance Criterion	Corrective Actions
Sulfate	EPA Method 375.2	Method blank	One per analytical batch	$\leq 3 \text{ mg/L}$	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	1 per 20 samples or per analytical batch, whichever is more frequent	$\text{RPD} \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS	1 per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
Chloride	EPA Method 325.1 or EPA 325.2	Method blank	One per analytical batch	$\leq 1 \text{ mg/L}$	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	1 per 20 samples or per analytical batch, whichever is more frequent	$\text{RPD} \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS	1 per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

**TABLE 8-1**  
**SUMMARY OF CLP SAS REQUEST INTERNAL QC PROCEDURES**

Page 3 of 3

Analyte	Analytical Method	QC Check	Frequency	Acceptance Criterion	Corrective Actions
CH <sub>4</sub> , ethane, and ethene	Laboratory standard operating procedure	Method blank	One per analytical batch	≤ 0.5 µg/L	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data with concentrations less than 5 times method blank concentrations
		LCS	One per analytical batch	70 to 130 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		MS/MSD	1 per 20 samples or per 24 hours, whichever is more frequent	RPD ≤ 30% and 70 to 130 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

≤ = Less than or equal to  
± = Plus or minus  
%R = Percent recovery  
CH<sub>4</sub> = Methane  
CLP = Contract Laboratory Program  
EPA = U.S. Environmental Protection Agency  
LCS = Laboratory check standard

MS/MSD = Matrix spike/matrix spike duplicate  
mg/L = Milligram per liter  
µg/L = Microgram per liter  
PRQL = Project-required quantitation limit  
QC = Quality control  
RPD = Relative percent difference  
SAS = Special analytical services

## **SECTION 9**

### **DATA REDUCTION, VALIDATION, AND REPORTING**

This section discusses the data reduction, validation, and reporting procedures to be used.

#### **9.1 DATA REDUCTION**

Data from field measurements and off-site analytical activities at the CLP laboratory or CRL will be reduced using the procedures described below.

##### **9.1.1 Field Measurements**

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory. Raw field measurement data will be recorded in a field logbook. These data will be reduced or summarized, and the reduction or summary method will be documented in the data evaluation report.

##### **9.1.2 CLP Laboratory Services**

Samples collected at the Blackwell site will be sent to a CLP laboratory for analysis of the parameters listed in Table 7-1. Appropriate data and calculations will be recorded on analytical data sheets. CLP laboratory personnel will review the data and verify that the data and calculations are correct. Raw data will be kept on file at the laboratory as required by the CLP SOWs. After data have been reduced, evaluated, and reported, they will be sent to the EPA Region 5 TSS for validation.

##### **9.1.3 SAS Laboratory Services**

Samples collected at the Blackwell site will be sent to the CRL for analysis of the SAS analytes listed in Table 7-1. Data reduction will be performed according to specifications outlined in the CRL SOP. Appropriate data and calculations will be recorded on analytical data sheets. The laboratory data reviewer will verify that the appropriate analytical method was followed, detection limits are correct, and

calculations are correct. Raw data will be kept on file at the laboratory for at least 6 months after analysis. After the data have been reduced, evaluated, and reported, they will be sent to the EPA Region 5 TSS for data validation. If the CRL does not have adequate capacity or space, Tetra Tech will procure a laboratory to conduct the SAS analysis. Data reduction will be performed according to specifications outlined in the procured laboratory's SOPs. The laboratory will submit validated data to the Tetra Tech QA reviewer for review and evaluation.

## **9.2 DATA VALIDATION**

The Tetra Tech field sampling leader or his designee will review field data to ensure that the reported results are accurate, including reviewing field logbooks to ensure that no transcription errors occurred and that proper calibration procedures were followed.

The EPA Region 5 TSS will be responsible for all CLP laboratory and CRL data validation. Laboratory data will be validated according to "U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (EPA 1994a) and "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (EPA 1994b) procedures. All analytical data from the CLP laboratory or CRL will be validated by comparing the contents of the data packages and QA/QC results to the requirements in the respective methods. Raw laboratory data will be examined to ensure that reported results are accurate. If Tetra Tech procures a laboratory for SAS analyses, the laboratory will submit validated data to the Tetra Tech QA reviewer for review and evaluation.

## **9.3 DATA REPORTING**

Field data, including field instrument calibration activities, will be recorded in the field logbooks. The field data will then be compiled and reported to EPA in the data evaluation report.

The CLP laboratories and CRL will prepare and submit full analytical and QC reports to EPA Region 5 in compliance with requirements of the CLP SOWs and SOPs, respectively. Analytical data from the laboratory that may be procured by Tetra Tech will comply with the QA/QC and reporting requirements

presented in the SAS requests in Attachment A of this QAPP. The laboratory QA officer will perform a final review of the analytical report summaries to determine whether the report meets project requirements. The report format shall include the following (as applicable):

- A case narrative, including a statement of samples received; a description of any deviations from standard procedures; an explanation of qualifications regarding data quality; and a description of any other significant problems encountered during analysis
- An organic QA/QC report; surrogate spike results for each sample; MS/MSD results; method blank results; and initial and continuing calibration check results
- An inorganic QA/QC report, including Forms I through XIII; spike and duplicate results; method blank results; and initial and continuing calibration check results
- Field and laboratory chain-of-custody documentation pertaining to each sample delivery group

Analytical data summary tables will be prepared by the Tetra Tech field sampling team after sampling activities are complete. Analytical and QC reports will be provided to EPA in the data evaluation report.

## **SECTION 10**

### **PERFORMANCE AND SYSTEM AUDITS**

Performance and system audits of both field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the procedures described in the FSP and QAPP. Audits of field and laboratory activities include two independent parts: internal and external audits. These types of audits for field and laboratory activities are discussed below.

#### **10.1 FIELD AUDITS**

Internal audits of field activities, including sampling and measurement, may be conducted by the Tetra Tech QA reviewer or his designee. The audits will include examination of field sampling records, field instrument operating records, sample collection procedures, handling and packaging procedures, QA procedures, and chain-of-custody procedures. These audits may be conducted at the onset of the project to verify that all established procedures are followed. Follow-up audits may be conducted to verify that deficiencies have been corrected and to verify that QA procedures are maintained throughout the project.

External audits of field activities may be conducted by EPA Region 5. External audits may be conducted at any time during field investigation activities and may or may not be announced.

#### **10.2 LABORATORY AUDITS**

The CLP laboratories are audited on a regular basis by EPA. The EMSL in Las Vegas, Nevada, conducts system audits of the CLP laboratories on an annual basis and performance audits on a quarterly basis. The system audits include examining laboratory documentation of sample receipt, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records. As part of these performance audits, performance evaluation samples are sent to the CLP laboratories to assess laboratory precision and accuracy. If Tetra Tech procures a laboratory, the Tetra Tech QA reviewer may perform an audit or performance evaluation of the chosen laboratory.

## **SECTION 11**

### **PREVENTIVE MAINTENANCE PROCEDURES**

This section discusses preventive maintenance procedures for field equipment and instruments and for laboratory instruments.

#### **11.1 FIELD EQUIPMENT AND INSTRUMENTS**

Specific equipment manufacturer preventive maintenance procedures will be followed. Preventive maintenance procedures for this equipment and instruments are presented in Attachment B of the FSP.

Field instruments will be checked and calibrated daily and in accordance with manufacturer's instructions before use and before shipment or transport to the field. Backup instruments and equipment not available on site will be made available by 1-day shipment to avoid delays in the field schedule.

#### **11.2 LABORATORY INSTRUMENTS**

All laboratories participating in the CLP are required under the CLP SOWs for organic and inorganic analyses to have SOPs for preventive maintenance for each measurement system and required support activity. CRL instruments will be maintained according to CRL's SOPs. If Tetra Tech procures a laboratory, preventative maintenance will be performed in accordance with the laboratory's SOPs. All maintenance activities are required to be documented in logbooks to provide a maintenance history.

## SECTION 12

### ASSESSMENT OF DATA PRECISION, ACCURACY, AND COMPLETENESS

This section discusses the specific procedures conducted to assess data precision, accuracy, and completeness of field measurements and laboratory data.

#### 12.1 FIELD MEASUREMENTS

Field data will be assessed by the Tetra Tech field sampling leader or his designee. The Tetra Tech field sampling leader will review field measurements for compliance with QC criteria specified in the QAPP. Precision of field measurements will be assessed on the basis of the RPD of duplicate samples in accordance with Equation 12-2. The accuracy of field measurements will be assessed using daily calibration checks. Data completeness will be calculated using the following equation:

$$\text{Completeness (\%)} = \frac{\text{Number of valid measurements}}{\text{Number of measurements planned}} \times 100 \quad (12-1)$$

#### 12.2 LABORATORY DATA

Laboratory results will be assessed for compliance with the required precision, accuracy, and completeness criteria discussed below.

##### 12.2.1 Precision

The precision of laboratory analysis will be assessed by comparing the analytical results with MS/MSD results for organic or inorganic analysis. The RPD will be calculated for each pair of duplicate analyses using the following equation:

$$\text{RPD} = \frac{S - D}{(S + D)/2} \times 100 \quad (12-2)$$



where:

S = first sample value (original or MS value)

D = second sample value (duplicate or MSD value)

#### 12.2.2 Accuracy

The accuracy of laboratory results will be assessed using method blank, MS/MSD, and equipment blank analytical results. The %R of MS samples will be calculated using the following equation:

$$\%R = \frac{A - B}{C} \times 100 \quad (12-3)$$

where:

A = Analyte concentration determined experimentally from spiked sample

B = Analyte concentration determined by a separate analysis of the unspiked sample

C = Amount of the spike added

#### 12.2.3 Completeness

The completeness of laboratory analytical results will be calculated using Equation 12-1.

## **SECTION 13**

### **CORRECTIVE ACTIONS**

Corrective actions may be required to address analytical and equipment problems and noncompliance problems. Problems may occur during sampling and sample handling, sample preparation, laboratory instrument analysis, and data review. All problems will be corrected using a formal corrective action program that will be determined and implemented at the time the problem is identified. Corrective actions related to field measurement, laboratory analysis, and data validation and assessment are discussed below.

#### **13.1 FIELD MEASUREMENTS**

Technical staff and project personnel will be responsible for reporting all suspected technical or QC nonconformances or suspected deficiencies to the Tetra Tech site manager or the site manager's designee. The site manager will in turn be responsible for assessing the suspected problems in consultation with the Tetra Tech QA manager. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the site manager. No staff member will initiate corrective action without prior communication of findings to the Tetra Tech site manager. If corrective actions are insufficient, work may be stopped by a stop-work order issued by the EPA WAM. The site manager will be responsible for ensuring that corrective action for nonconformances are initiated by the following actions:

- Evaluating all reported nonconformances
- Controlling additional work on nonconforming items
- Determining actions to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective actions taken
- Ensuring that nonconformance reports are included in project files

The site manager will ensure that no additional work dependent on the nonconformance is performed until the corrective actions are completed.

Corrective action for field measurements taken at the Blackwell site may be required. Corrective actions for field measurements will be documented in the field logbook, and may include the following:

- Repeating the measurement
- Checking to ensure that all proper adjustments for ambient conditions (such as temperature) have been made
- Checking the batteries
- Recalibrating the instrument
- Checking the calibration
- Replacing the instrument or measurement device
- Stopping work (if necessary)

The site manager is responsible for all site activities and is therefore responsible for the adjustment of project-related activities to accommodate site-specific needs. If modifications to the field SOPs are necessary, or alternative SOPs are required, the Tetra Tech site manager will notify the EPA WAM and seek approval.

## **13.2 LABORATORY ANALYSIS**

Corrective action is implemented at several different levels for CLP laboratories and the CRL. CLP laboratories and the CRL are required to have written SOPs specifying corrective actions to be taken when analytical errors are discovered or when the analytical system is determined to be out of control. Each SOP requires documentation of the corrective actions taken, and the analyst must note the errors and associated corrective procedures.

EPA may also request that corrective action be taken for any contractual nonconformance identified by audits or data validation. The EPA Region 5 TSS may request corrective action for any nonconformances identified during the data validation process. For minor problems, the laboratory may be contacted directly. Corrective actions may include the following:

- Reanalyzing the samples if holding time criteria permit
- Resampling and reanalyzing
- Evaluating and amending sampling procedures and/or evaluating and amending analytical procedures
- Accepting the data and acknowledging the level of uncertainty

The EPA WAM or his designee will issue a nonconformance report for each nonconformance situation. If resampling is deemed necessary because of laboratory problems, the EPA WAM must identify the necessary approach, including cost recovery from the CLP laboratories and the CRL for the additional sampling effort.

Corrective actions by non-CLP laboratories will be performed in accordance with the approved non-CLP laboratory SOPs.

### **13.3 CORRECTIVE ACTION DURING DATA VALIDATION AND ASSESSMENT**

Tetra Tech may identify the need for corrective action during assessment of validated data received from the CLP laboratory, CRL, or non-CLP laboratory procured by Tetra Tech. The Tetra Tech data assessor will report all corrective action requirements to the Tetra Tech site manager. After consultation with EPA, the Tetra Tech site manager will be responsible for approving and implementing the corrective actions. Corrective actions may include resampling by the field team or reanalysis by the laboratory. All corrective actions will be documented by the Tetra Tech site manager and reported to the Tetra Tech QA reviewer.

## **SECTION 14**

### **QUALITY ASSURANCE REPORTS TO MANAGEMENT**

A QA/QC report that summarizes all data quality information collected during the field investigation will be submitted as part of the natural attenuation evaluation report to the EPA WAM. The QA/QC report will also be distributed to Tetra Tech's corporate QA manager and ARCs program manager. The QA/QC report will include the following information:

- Status of the project
- Changes in the QAPP
- Summary of QA/QC programs
- Results of technical systems and performance evaluation audits
- Significant QA/QC problems, recommended solutions, and corrective action results and their impact on the project
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and method detection limits
- Indication of whether QA objectives have been met
- Limitations to the use of measurement data
- Changes in key personnel

## REFERENCES

- Air Force Center for Environmental Excellence (AFCEE). 1995 "Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater." Revision 0. November 11.
- U.S. Environmental Protection Agency (EPA). 1983. *Methods for Chemical Analysis of Water and Wastes*. EPA/600/4-7-020. Revised March 1983.
- EPA. 1985. "National Enforcement Investigation Center (NEIC) Policies and Procedures." EPA-330/9-78/001-R. Revised June.
- EPA. 1994a. "U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review." Office of Solid Waste and Emergency Response. Washington, D.C. OSWER Publication 9240.1-05. February.
- EPA. 1994b. "U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review." Office of Solid Waste and Emergency Response. Washington, D.C. OSWER Publication 9240.1-05. February.
- EPA. 1994c. "Requirements for Quality Assurance Project Plans for Environmental Data Operations." QA/R-5. August.
- EPA. 1996a. "Region 5 Superfund Model Quality Assurance Project Plan." Revision 1, May.
- EPA. 1996b. "Drinking Water Regulations and Health Advisories." Office of Water. EPA Document No. 822-B-96-002. October.
- EPA. 1997. "Proceedings of the Symposium on Natural Attenuation of Chlorinated Organics in Ground Water." EPA/540/R-97/504. May.
- Montgomery Watson, Inc. (MW). 1996. "Quality Assurance Project Plan Pre-Design Investigation Activities." August.
- U.S. Geologic Survey (USGS). 1980. 7.5-Minute Topographic Map of Naperville, Illinois, Quadrangle.
- Warzyn, Inc (Warzyn). 1994. "Final Remedial Investigation Report for the Blackwell Landfill NPL Site." December 1994.

**ATTACHMENT A**  
**REQUESTS FOR SPECIAL ANALYTICAL SERVICES**  
**(50 Pages)**

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PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
ALKALINITY ANALYSIS OF GROUNDWATER SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for alkalinity in groundwater samples using EPA Method 310.1.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 23 groundwater samples, including 16 investigative samples, 2 duplicate samples, 2 equipment blanks, 2 trip blanks, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 310.1. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-5J)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 310.1

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for alkalinity analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 310.1 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Alkalinity	EPA Method 310.1	Titrant standardization	As detailed in Section 4.1 of EPA Method 310.1	As detailed in Section 4.1 of EPA Method 310.1	Repeat standardization
		pH meter or titrator calibration	As detailed in Section 4.1 of EPA Method 310.1	As detailed in Section 4.1 of EPA Method 310.1	Repeat calibration

Note:

QC = Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Alkalinity	EPA Method 310.1	Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	RPD $\leq$ 10%	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	$\pm$ 10 percent of standard value	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

- $\leq$  = Less than or equal to
- $\pm$  = Plus or minus
- LCS = Laboratory check standard
- QC = Quality control
- RPD = Relative percent difference
- \* = Potassium nitrate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

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**Request for  
SPECIAL ANALYTICAL SERVICES  
ALKALINITY ANALYSIS OF LEACHATE SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for alkalinity in leachate samples using EPA Method 310.1.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 11 leachate samples, including 7 investigative samples, 1 duplicate sample, 1 equipment blank, 1 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 310.1. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 310.1

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for alkalinity analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 310.1 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.



**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Alkalinity	EPA Method 310.1	Titrant standardization	As detailed in Section 4.1 of EPA Method 310.1	As detailed in Section 4.1 of EPA Method 310.1	Repeat standardization
		pH meter or titrator calibration	As detailed in Section 4.1 of EPA Method 310.1	As detailed in Section 4.1 of EPA Method 310.1	Repeat calibration

Note:

QC = Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Alkalinity	EPA Method 310.1	Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	RPD $\leq$ 10%	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	$\pm$ 10 percent of standard value	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

- $\leq$  = Less than or equal to
- $\pm$  = Plus or minus
- LCS = Laboratory check standard
- QC = Quality control
- RPD = Relative percent difference
- \* = Potassium nitrate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

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**Request for  
SPECIAL ANALYTICAL SERVICES  
CHLORIDE ANALYSIS OF GROUNDWATER SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/ Region 5  
RSCC Representative: Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for chloride in groundwater samples using EPA Method 325.1 or 325.2.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 23 groundwater samples, including 16 investigative samples, 2 duplicate samples, 2 equipment blanks, 2 trip blanks, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund (Remedial or Enforcement), RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 325.1 or 325.2. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data; forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 325.1 or 325.2

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for chloride analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 325.1 or 325.2 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Chloride	EPA Method 325.1 or 325.2	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	Beginning and end of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard. 3. Repeat initial calibration

Notes:

$r^2$         =        Correlation coefficient  
 $\geq$          =        Greater than or equal to  
 QC        =        Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Chloride	EPA Method 325.1 or 325.2	Method blank	One per analytical batch	$\leq 1 \text{ mg/L}$	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	$\text{RPD} \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

$\leq$	=	Less than or equal to
LCS	=	Laboratory check standard
mg/L	=	Milligram per liter
QC	=	Quality control
RPD	=	Relative percent difference
%R	=	Percent recovery
*	=	Sodium chloride should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX 938-0118

SAS Number

ZF\_\_

***Request for***  
**SPECIAL ANALYTICAL SERVICES**  
**CHLORIDE ANALYSIS OF LEACHATE SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for chloride in leachate samples using EPA Method 325.1 or 325.2.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 11 leachate samples, including 7 investigative samples, 1 duplicate sample, 1 equipment blank, 1 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 325.1 or 325.2. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.



8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 325.1 or 325.2

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for chloride analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 325.1 or 325.2 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Chloride	EPA Method 325.1 or 325.2	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	Beginning and end of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard. 3. Repeat initial calibration

Notes:

$r^2$         =     Correlation coefficient  
 $\geq$          =     Greater than or equal to  
 QC        =     Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Chloride	EPA Method 325.1 or 325.2	Method blank	One per analytical batch	$\leq 1 \text{ mg/L}$	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	$\text{RPD} \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

$\leq$	=	Less than or equal to
LCS	=	Laboratory check standard
mg/L	=	Milligram per liter
QC	=	Quality control
RPD	=	Relative percent difference
%R	=	Percent recovery
*	=	Sodium chloride should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
METHANE, ETHANE, AND ETHENE ANALYSIS OF GROUNDWATER SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/ Region 5  
RSCC Representative: Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-Q084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for methane, ethane, and ethene in groundwater samples using a laboratory standard operating procedure (SOP).

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 23 groundwater samples, including 16 investigative samples, 2 duplicate samples, 2 equipment blanks, 2 trip blanks, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund (Remedial or Enforcement), RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use its SOP for analysis for methane, ethane, and ethene. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

The laboratory SOP should be based on the headspace sample preparation method, SW-846 Method 3810, followed by the gas chromatographic determinative method, ASTM Method D3416. The laboratory reporting limit for analyzing for methane, ethane, and ethene in groundwater samples should be less than or equal to 0.5 micrograms per liter for each analyte.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data; forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with the laboratory SOP

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for methane, ethane, and ethene analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in the laboratory SOP and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Methane, ethane, and ethene	Laboratory SOP	Initial calibration	Before sample analysis	$r^2 \geq 0.995$	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Rerun one point on the calibration curve</li> <li>3. If <math>r^2</math> is still less than 0.995 then rerun entire calibration curve</li> </ol>
		Continuing calibration	One per 20 or fewer samples per matrix and at the end of an analytical batch	Instrument response within 15 percent of calibration standard value	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Reanalyze with a fresh standard</li> <li>3. Repeat initial calibration</li> <li>4. Reanalyze samples analyzed since last failed calibration check</li> </ol>

Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control  
 SOP = Standard operating procedure



**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Methane, ethane, and ethene	Laboratory SOP	Method blank	One per analytical batch	$\leq 0.5 \mu\text{g/L}$	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of contamination</li> <li>3. Flag data with concentrations less than 5 times method blank concentrations</li> </ol>
		LCS*	One per analytical batch	70 to 130 %R	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of error and repeat analysis</li> <li>3. Flag data</li> </ol>
		MS/MSD	One per 20 samples or 24 hours, whichever is more frequent	RPD $\leq$ 30% 70 to 130 %R	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of error and repeat analysis</li> <li>3. Flag data</li> </ol>

Notes:

- $\leq$  = Less than or equal to
- LCS = Laboratory check standard
- QC = Quality control
- RPD = Relative percent difference
- SOP = Standard operating procedure
- %R = Percent recovery
- $\mu\text{g/L}$  = Microgram per liter
- MS/MSD = Matrix spike and matrix spike duplicate
- \* = A 1% gas standard of methane, ethane, and ethene in nitrogen or helium should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
METHANE, ETHANE, AND ETHENE ANALYSIS OF LEACHATE SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for methane, ethane, and ethene in leachate samples using a laboratory standard operating procedure (SOP).

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 11 leachate samples, including 7 investigative samples, 1 duplicate sample, 1 equipment blank, 1 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use its SOP for analysis for methane, ethane, and ethene. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

The laboratory SOP should be based on the headspace sample preparation method, SW-846 Method 3810, followed by the gas chromatographic determinative method, ASTM Method D3416. The laboratory reporting limit for analyzing for methane, ethane, and ethene in leachate samples should be less than or equal to 0.5 micrograms per liter for each analyte.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data; forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-5J)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with the laboratory SOP

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for methane, ethane, and ethene analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in the laboratory SOP and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Methane, ethane, and ethene	Laboratory SOP	Initial calibration	Before sample analysis	$r^2 \geq 0.995$	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Rerun one point on the calibration curve</li> <li>3. If <math>r^2</math> is still less than 0.995 then rerun entire calibration curve</li> </ol>
		Continuing calibration	One per 20 or fewer samples per matrix and at the end of an analytical batch	Instrument response within 15 percent of calibration standard value	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Reanalyze with a fresh standard</li> <li>3. Repeat initial calibration</li> <li>4. Reanalyze samples analyzed since last failed calibration check</li> </ol>

Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control  
 SOP = Standard operating procedure

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Methane, ethane, and ethene	Laboratory SOP	Method blank	One per analytical batch	$\leq 0.5 \mu\text{g/L}$	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of contamination</li> <li>3. Flag data with concentrations less than 5 times method blank concentrations</li> </ol>
		LCS*	One per analytical batch	70 to 130 %R	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of error and repeat analysis</li> <li>3. Flag data</li> </ol>
		MS/MSD	One per 20 samples or 24 hours, whichever is more frequent	$\text{RPD} \leq 30\%$ 70 to 130 %R	<ol style="list-style-type: none"> <li>1. Check calculations</li> <li>2. Assess and eliminate sources of error and repeat analysis</li> <li>3. Flag data</li> </ol>

Notes:

- $\leq$  = Less than or equal to
- LCS = Laboratory check standard
- MS/MSD = Matrix spike and matrix spike duplicate
- $\mu\text{g/L}$  = Microgram per liter
- QC = Quality control
- RPD = Relative percent difference
- %R = Percent recovery
- SOP = Standard operating procedure
- \* = A 1% gas standard of methane, ethane, and ethene in nitrogen or helium should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
NITRATE ANALYSIS OF GROUNDWATER SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/ Region 5  
RSCC Representative: Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for nitrate in groundwater samples using EPA Method 352.1.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 23 groundwater samples, including 16 investigative samples, 2 duplicate samples, 2 equipment blanks, 2 trip blanks, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 352.1. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

**Data Package Recipient Addresses**

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling



**I. DATA REQUIREMENTS**

In accordance with EPA Method 352.1

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for nitrate analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 352.1 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Nitrate	EPA Method 352.1	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At the beginning and end of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard. 3. Repeat initial calibration

Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Nitrate	EPA Method 352.1	Method blank	One per analytical batch	$\leq 0.1$ mg/L	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	$RPD \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

- $\leq$  = Less than or equal to
- LCS = Laboratory check standard
- mg/L = Milligram per liter
- QC = Quality control
- RPD = Relative percent difference
- %R = Percent recovery

\* = Potassium nitrate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
NITRATE ANALYSIS OF LEACHATE SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for nitrate in leachate samples using EPA Method 352.1.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 11 leachate samples, including 7 investigative samples, 1 duplicate sample, 1 equipment blank, 1 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 352.1. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 352.1

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for nitrate analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 352.1 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Nitrate	EPA Method 352.1	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At the beginning and end of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard. 3. Repeat initial calibration

Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Nitrate	EPA Method 352.1	Method blank	One per analytical batch	$\leq 0.1$ mg/L	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	$RPD \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

- $\leq$  = Less than or equal to  
 LCS = Laboratory check standard  
 mg/L = Milligram per liter  
 QC = Quality control  
 RPD = Relative percent difference  
 %R = Percent recovery  
 \* = Potassium nitrate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.



Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
SULFATE ANALYSIS OF GROUNDWATER SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for sulfate in groundwater samples using EPA Method 375.2.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 23 groundwater samples, including 16 investigative samples, 2 duplicate samples, 2 equipment blanks, 2 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 375.2. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. **Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):**

Tetra Tech has no special technical instructions.

9. **Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.**

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. **Other (use additional sheets or attach supplementary information, as needed):**

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. **Name of sampling/shipping contact:** Kostas Dovantzis  
**Office Phone:** (312) 856-8757  
**(Optional) Field Phone:** To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 375.2

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for sulfate analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 375.2 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.

**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Sulfate	EPA Method 375.2	Initial calibration	Before sample analysis	$r^2 \geq 0.99$	1. Check calculations 2. Repeat calibration
		Continuing calibration	At beginning and end of each sample batch; after every 20 samples	Instrument response within 10 percent of calibration standard value	1. Check calculations 2. Repeat check with a fresh standard 3. Repeat initial calibration

Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control

**TABLE 2 SUMMARY OF LABORATORY INTERNAL QC PROCEDURES**

Parameter	Analytical Method	QC Check	Frequency	Acceptance Criteria	Corrective Action
Sulfate	EPA Method 375.2	Method blank	One per analytical batch	$\leq 3 \text{ mg/L}$	1. Check calculations 2. Assess and eliminate sources of contamination 3. Flag data
		Laboratory duplicate	One per 20 samples or per analytical batch, whichever is more frequent	$\text{RPD} \leq 20\%$	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data
		LCS*	One per 20 samples or per analytical batch, whichever is more frequent	80 to 120 %R	1. Check calculations 2. Assess and eliminate sources of error and repeat analysis 3. Flag data

Notes:

- $\leq$  = Less than or equal to
- LCS = Laboratory check standard
- mg/L = Milligram per liter
- QC = Quality control
- RPD = Relative percent difference
- %R = Percent recovery
- \* = Sodium sulfate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

Tetra Tech EM Inc.  
200 E. Randolph Drive, Suite 4700  
Chicago, IL 60601  
PHONE: (312) 856-8700 or FAX (312) 938-0118

SAS Number

ZF\_\_

**Request for  
SPECIAL ANALYTICAL SERVICES  
SULFATE ANALYSIS OF LEACHATE SAMPLES**

A. Client: Tetra Tech EM Inc. (Tetra Tech)  
B. EPA Region/  
RSCC Representative: Region 5  
Cecilia Moore  
C. Tetra Tech Contact: Kostas Dovantzis  
D. Telephone Number: (312) 856-8757  
E. Date of Request: January 16, 1998 Date of Sampling: March 1998  
F. ARCS Contract No.: 68-W8-0084 Work Assignment No.: 84-5P6Y

Provided below is a description of requested Special Analytical Services (SAS). This SAS request follows the same format and content as the U.S. Environmental Protection Agency's (EPA) SAS requests.

**1. General description of analytical service requested:**

This request is for analysis for sulfate in leachate samples using EPA Method 375.2.

**2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):**

A total of 11 leachate samples, including 7 investigative samples, 1 duplicate sample, 1 equipment blank, 1 trip blank, and 1 matrix spike and matrix spike duplicate sample, are involved.

**3. Purposes of analysis (specify whether Superfund (Remedial or Enforcement), RCRA, NPDES, etc.):**

Superfund remedial action investigation

**4. Estimated date(s) of collection:**

Tetra Tech anticipates that samples will be collected in March 1998.

**5. Estimated date(s) and method of shipment:**

Samples will be shipped daily by overnight carrier. The laboratory will be notified no later than 1 week before collection of the first batch of samples and at the time of each subsequent shipment.

**6. Number of days analysis and data required after laboratory receipt of samples:**

The laboratory should submit a full data package within 30 days of receipt of each batch of samples.

**7. Analytical protocol required (attach copy if other than an established SAS protocol):**

The laboratory should use protocols described in EPA Method 375.2. Laboratory instrument calibration requirements are presented in Table 1 of this SAS request. No other methods may be used. Data rejection and nonpayment will be recommended if a method other than the one specified in this SAS request is used.

8. Special technical instruction (if outside established SAS protocol requirements, specify compound names, CAS numbers, detection limits, etc.):

Tetra Tech has no special technical instructions.

9. Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to laboratory discretion.

The laboratory should follow Contract Laboratory Program (CLP) format, which may be modified by omission of nontarget analytes. Preliminary data can consist of legible entries for sample number and analyte concentration. The final data package must meet the following requirements:

All procedures must be clearly identified. All raw data: forms; calculations; worksheets; instrument readouts; preparation forms; internal sample and/or extract chain-of-custody forms; strip charts; and copies of pages from preparation, weighing, and analysis notebooks must be submitted. The laboratory must submit records of weighings of all samples, blanks, duplicates, and reference samples, including initial, intermediate, and final weighings. If originals are submitted in another data package, photocopies may be submitted with a record of the location of the originals.

All records of analysis and calculation must be legible and sufficient to recalculate all sample concentrations and quality assurance (QA) audit results. Quality control (QC) reference samples or initial calibration standards must be identified by source, lot number, and sample number.

One copy of the final data package must be sent to Cecilia Moore, EPA Regional Sample Control Coordinator (RSCC), for data validation, and one copy must be sent to Kostas Dovantzis, Tetra Tech site manager, for contract compliance screening.

10. Other (use additional sheets or attach supplementary information, as needed):

All original sample tags, chain-of-custody forms, SAS packing lists, airbills, and original data must be submitted to Cecilia Moore, EPA RSCC, within the timeframe listed in Item 6 above. Photocopies of chain-of-custody forms and airbills may be submitted instead of originals along with a record of the location of the originals. Photocopies of all sample tags, forms, lists, and other data submitted to the EPA RSCC as originals must be submitted to Kostas Dovantzis, Tetra Tech site manager, within the timeframe listed in Item 6 above.

#### Data Package Recipient Addresses

(Originals for Data Validation)  
Ms. Cecilia Moore (SM-J5)  
Regional Sample Control Coordinator  
U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Boulevard  
Chicago, IL 60604

(Photocopies for Compliance Screening)  
Mr. Kostas Dovantzis  
Tetra Tech EM Inc.  
200 E. Randolph Drive  
Suite 4700  
Chicago, IL 60601

11. Name of sampling/shipping contact: Kostas Dovantzis  
Office Phone: (312) 856-8757  
(Optional) Field Phone: To be provided 1 week before sampling

**I. DATA REQUIREMENTS**

In accordance with EPA Method 375.2

**II. QC REQUIREMENTS**

Table 2 in this SAS request presents internal QC requirements for sulfate analysis.

**III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:**

Follow actions specified in EPA Method 375.2 and in Tables 1 and 2 of this SAS request. Contact Tetra Tech (see Item 11) if any unusual problems occur.



**TABLE 1 SUMMARY OF LABORATORY INSTRUMENT CALIBRATION REQUIREMENTS**

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Notes:

$r^2$  = Correlation coefficient  
 $\geq$  = Greater than or equal to  
 QC = Quality control

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- LCS = Laboratory check standard
- mg/L = Milligram per liter
- QC = Quality control
- RPD = Relative percent difference
- %R = Percent recovery
- \* = Sodium sulfate should be used as the stock solution for the laboratory check standard. The stock solution should be prepared from a stock solution batch not used for instrument calibration.

**Appendix B - Draft Field  
Sampling Plan**

**APPENDIX B**

**DRAFT FIELD SAMPLING PLAN FOR**  
**BLACKWELL FOREST PRESERVE LANDFILL**  
**DuPAGE COUNTY, ILLINOIS**

**DRAFT FIELD SAMPLING PLAN FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

**Prepared for  
U.S. Environmental Protection Agency  
Region 5  
Chicago, Illinois**

Work Assignment No.	:	84-5P6Y
Contract No.	:	68-W8-0084
Tetra Tech No.	:	030-008401RA
EPA Work Assignment Manager	:	Michael Bellot
Telephone No.	:	(312) 353-6425
Date Prepared	:	January 22, 1998
Prepared by	:	Tetra Tech EM Inc. (Kevin Schnoes)
Tetra Tech Site Manager	:	Kostas Dovantzis
Telephone No.	:	(312) 856-8757

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- B MANUFACTURER'S INSTRUCTIONS

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## **1.0 INTRODUCTION**

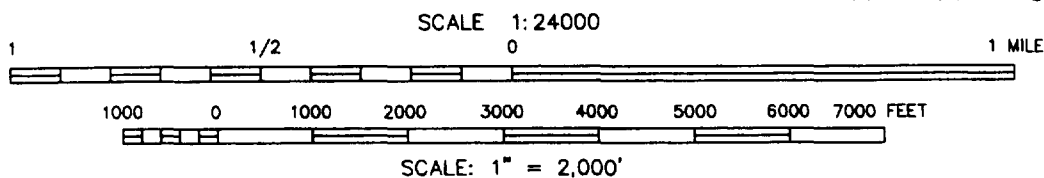
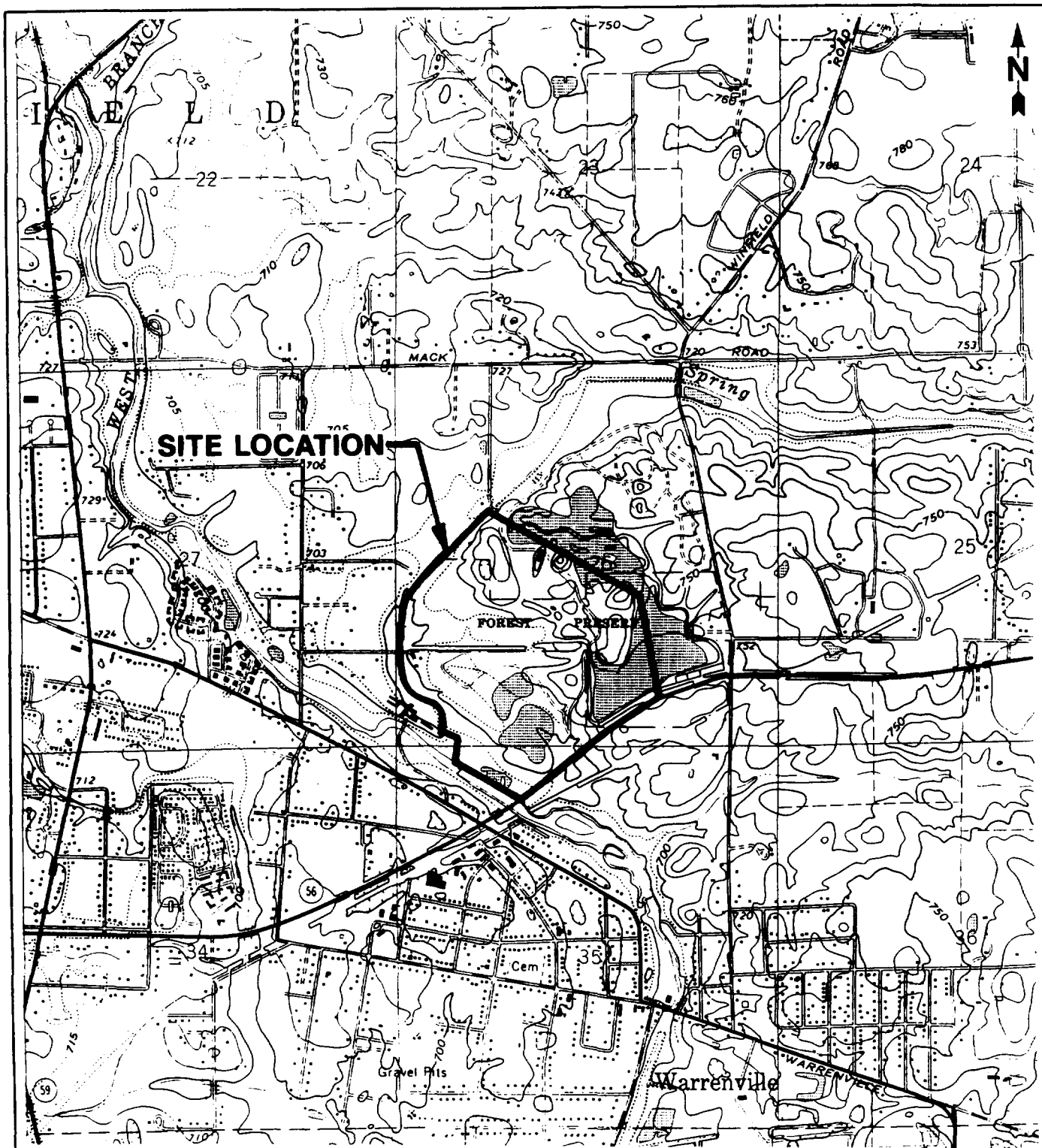
Tetra Tech EM Inc. (Tetra Tech) has prepared this field sampling plan (FSP) as part of the sampling and analysis plan (SAP) for the Blackwell Forest Preserve Landfill (Blackwell) site in Warrenville, DuPage County, Illinois, under U.S. Environmental Protection Agency (EPA) Alternative Remedial Contracting Strategy (ARCS) Contract No. 68-W8-0084, Work Assignment (WA) No. 84-5P6Y. The Blackwell site is owned by the DuPage County Forest Preserve District (FPD). This FSP describes activities to be conducted during a field investigation at the Blackwell site to collect samples for evaluating natural attenuation and split samples for assessing the accuracy of the analytical laboratory used by the FPD. Quality assurance (QA) and quality control (QC) protocols associated with sampling and analytical activities are presented in the quality assurance project plan (QAPP), which is also contained in the SAP. The SAP consists of the QAPP (Appendix A) and the FSP (Appendix B) and is part of the site-specific plans prepared under this WA in accordance with Task 1.2 of the EPA statement of work (SOW) for work plan Amendment No. 2.

This FSP consists of nine sections besides this introduction. Section 2.0 presents a site description and history; Section 3.0 describes project objectives; Section 4.0 describes proposed field sampling activities; Section 5.0 describes decontamination procedures; Section 6.0 describes sample handling procedures; Section 7.0 presents the tentative schedule for field activities; Section 8.0 discusses the disposal of investigation-derived waste (IDW); Section 9.0 describes health and safety procedures; Section 10.0 discusses QA requirements; and Section 11.0 presents references cited in the FSP.

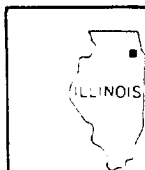
## **2.0 SITE DESCRIPTION AND HISTORY**

The Blackwell site covers 40 acres in the central portion of the 1,200-acre Blackwell Forest Preserve in Warrenville, Illinois (see Figure B-1). The landfill is located in the central portion of the forest preserve, which is bordered on all sides by residences. Construction of the landfill began in 1965, and landfiling of waste material continued until 1973. In 1975, the landfill was capped with clay and contoured to form the recreational hill present at the site. The landfill contains about 1.5 million cubic yards of refuse





SOURCE: MODIFIED FROM USGS,  
NAPERVILLE, ILLINOIS, QUADRANGLE, 1980



Quadrangle Location

BLACKWELL FOREST PRESERVE LANDFILL  
DU PAGE COUNTY, ILLINOIS

**FIGURE B-1**  
**SITE LOCATION**

**Tt Tetra Tech EM Inc.**

classified as general household refuse and light industrial waste and an equal volume of natural fill (Warzyn 1994).

In March 1986, the site was evaluated by EPA and proposed for inclusion on the National Priorities List (NPL). The site was proposed for inclusion on the NPL in June 1988. On September 25, 1989, a consent order was signed for the Blackwell site by FPD and EPA. After the site's final listing on the NPL on February 21, 1990, a remedial investigation (RI) and feasibility study were performed at the site. Groundwater contamination downgradient of the landfill was detected during the RI. On March 7, 1996, an administrative order by consent for the site was signed by the FPD and EPA to address installation of leachate extraction wells, performance of a predesign investigation, design of a leachate collection system (LCS), and cap repair. Leachate extraction wells were installed at the site in June 1996, and the predesign investigation began in October 1996. In February 1997, Montgomery Watson, Inc. (MW), consultant to the FPD, submitted a work plan for final remedial design activities at the site. The activities discussed in the work plan include recapping of certain areas of the landfill and installation of the LCS (MW 1997b). Recapping of a portion of the landfill occurred in August and September of 1997. Recapping of the remaining areas of the landfill will be completed in Spring 1998. The LCS installation occurred from September through November 1997.

The Blackwell site is located over the contact of an outwash aquifer and the Wisconsin-aged Yorkville Till. Upgradient of the landfill there is a more frequent occurrence of till and less frequent occurrence of glacial outwash deposits. Upgradient of the landfill, the following hydrostratigraphic units, in ascending order, are present: the bedrock aquifer, the Wisconsin-aged Malden/Tiskilwa Till aquitard, and the Yorkville Till aquitard and lesser amounts of glacial outwash deposits. Downgradient of the landfill, the following units, in ascending order, are present: the bedrock aquifer, the Malden/Tiskilwa Till aquitard, and the outwash aquifer. The outwash and bedrock aquifers are hydraulically connected. Groundwater flow in the area is generally southwest. Groundwater in the outwash aquifer is encountered from approximately 687 to 707 feet above mean sea level (Warzyn 1994). Depth to groundwater varies due to the significant relief of the landfill; however, downgradient of the landfill the depth to groundwater is about 20 feet.

Site soils, surface water, sediment, and groundwater were previously sampled by Warzyn, Inc., consultant to FPD, during the RI. Table B-1 summarizes sampling results of matrices sampled during the RI. Results

**TABLE B-1**

**SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA\***

Page 1 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
<b>Metals</b>									
Aluminum		/50		56	1,520	34,600	7,760	16,000	
Antimony		6		8.2	3.6				
Arsenic	50	50	18.4	14.2		45.7	9.4	7.4	
Barium	2,000	2,000	632	135	44	612	109	182	
Cadmium (water)	5	5		0.87		150			
Cadmium (soil)								5.7	
Calcium			269,000	122,000	117,000	3,030,000	179,000	127,000	
Chromium	100	100/				144	17.8	70.8	
Cobalt	1,000		18			550	9.3	16.5	
Copper	650	1,300/1,000		71.5	39	86	62.9	58.9	
Iron	3,000	/300	23,700*	3,620*	2,540	2,410,000	16,500	24,300	
Lead	7.5	15/		86.4*	10.9	482	28.3	36.7	
Magnesium			121,000	77,100	52,400	4,010,000	58,300	70,400	
Manganese	150	/50	4,880*	96*	72	59,800	694	1,570	
Mercury	2	2/	0.29		0.34	4.7	0.16	0.2	

TABLE B-1

SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA<sup>a</sup>

Page 2 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
Metals (Continued)									
Nickel	100	100/	74	21.5		501	11.3	28.4	
Potassium			41,300	7,720	14,200	1,230,000	1,330	1,820	
Selenium	50	50/						2.2	
Silver	50	/100		1.2		45		2.2	
Sodium			212,000	356,000	342,000	1,200,000			
Thallium		2/				139		0.68	
Vanadium						442	21	39	
Zinc	5,000	/5,000	124	400	72	126,000	149	150	
Cyanide	200	200/	11		13	13			
Organics									
Chloromethane									930
Vinyl chloride	2	2/	31*			22	5		21,000
Chloroethane			15						630
Methylene chloride		5/	17*						17,000
Acetone						10,000			2,800

**TABLE B-1**

**SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA<sup>a</sup>**

Page 3 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
Organics (Continued)									
Carbon disulfide			1			2	5		
1,1-Dichloroethane			8	1		180	3		26,000
1,2-Dichloroethene (total)	70	70/	120*	2		480			46,300
1,2-Dichloroethane	5	5/	1						
2-Butanone						17,000			9,200
1,1,1-Trichloroethane	200	200/	1					2	
1,2-Dichloropropane	5	5/	5*			89			1,400
Trichloroethene	5	5/	18*			720			28,000
Benzene	5	5/	5*			160			2,700
4-Methyl-2-pentanone						1,100			6,000
Tetrachloroethene	5	5/	12*			220			17,000
Toluene	1,000	1,000/				3,200			92,000
Chlorobenzene	100	100/				28			160
Ethylbenzene	700	700/				130			79,000
Xylenes (total)	10,000	10,000/				470			17,000

TABLE B-1

## SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA\*

Page 4 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
Organics (Continued)									
Dichlorodifluoromethane									12,000
Dichlorotetrafluoromethane									1,200
Trichlorofluoromethane									200
Trichlorotrifluoroethane									250
4-Ethyltoluene									14,000
1,3,5-Trimethylbenzene									1,900
1,2,4-Trimethylbenzene									4,300
Phenol			23			26			
1,4-Dichlorobenzene	75	75				940			7,300
1,2-Dichlorobenzene	600	600				4			
2-Methylphenol						6			
4-Methylphenol						17,000			
Isophorone						12			
2,4-Dimethylphenol						10			
Naphthalene						960			

**TABLE B-1**

**SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA\***

Page 5 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
Organics (Continued)									
4-Chloro-3-methylphenol						34			
2-Methylnaphthalene						7			
Dibenzofuran						1			
Diethylphthalate						230			
Acenaphthene							78		
Fluorene						1	140		
N-nitrosodiphenylamine						3			
Pentachlorophenol	1	1				3			
Phenanthrene						1	450	170	
Anthracene							170		
Di-n-butylphthalate						2			
Fluoranthene							2,200	340	
Pyrene			1				1,600	290	
Butylbenzylphthalate							77		
Benzo(a)anthracene							730	170	

TABLE B-1

SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA<sup>a</sup>

Page 6 of 7

Chemical	IAC Groundwater Criteria <sup>b</sup> (µg/L)	MCL/ SMCL <sup>c</sup> (µg/L)	Groundwater (µg/L)	Private Well (µg/L)	Surface Water (µg/L)	Leachate (µg/L)	Sediments (µg/kg)	Surface Soil (µg/kg)	Landfill Gas (ppb V/V)
Organics (Continued)									
Chrysene							980	210	
bis(2-ethylhexyl)phthalate		6	29*				1,500		
Di-n-octyl phthalate			4						
Benzo(b)fluoranthene							2,000	580	
Benzo(k)fluoranthene							2,000	580	
Benzo(a)pyrene		0.2					790	190	
Indeno(1,2,3-cd)pyrene							550	180	
Dibenz(a,h)anthracene							500		
Benzo(g,h,i)perylene							4,400	210	
Dieldrin				1.0E-02					
4,4'-DDE				9.0E-03					
Endrin	2	2		1.4E-02					
4,4'-DDD				6.0E-03					
PCB	0.5	0.5						56	
Endrin Aldehyde				3.0E-03					



**TABLE B-1**

**SUMMARY OF MAXIMUM DETECTED CONCENTRATIONS BY MEDIA<sup>a</sup>**

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Notes:

- <sup>a</sup> This table presents Illinois Administrative Code (IAC) groundwater criteria, maximum contaminant level/secondary maximum contaminant level (MCL/SMCL), and medium-specific maximum concentrations of inorganic and organic chemicals measured in samples collected from the Blackwell Landfill site, as presented in Table 5-1 of the remedial investigation (Warzyn 1994).
- <sup>b</sup> IAC groundwater criteria presents potable resource groundwater criteria (35 IAC Section 620.410), as presented in the RI (Warzyn 1994).
- <sup>c</sup> MCLs and SMCLs established by the U.S. Environmental Protection Agency (November 1991), are listed as presented in the RI (Warzyn 1994).
- <sup>\*</sup> Indicates regulatory limit equaled or exceeded for aqueous medium.

ppb V/V = Part per billion by volume

µg/L = Micrograms per liter

µg/kg = Micrograms per kilogram

from the RI indicate that groundwater downgradient of the landfill contains volatile organic compounds (VOC) at concentrations equaling or exceeding maximum contaminant levels (MCL), including vinyl chloride; 1,2-dichloroethene; trichloroethene; tetrachloroethene; 1,2-dichloropropane; and benzene. VOCs were not detected in surface water samples collected from Silver Lake, Sand Pond, Pine Lake, or Spring Brook which are located south and west of the landfill. However, vinyl chloride; carbon disulfide; and 1,1-dichloroethane were detected in sediment samples collected from Sand Pond. No VOCs were detected in soil samples collected from the landfill cover (Warzyn 1994).

### **3.0 PROJECT OBJECTIVES**

The objectives of this field investigation are to (1) gather necessary data to assist EPA in conducting an independent evaluation of natural attenuation at the Blackwell site and (2) conduct split sampling and analysis of surface water, soil, and sediment to assess the analytical accuracy of the laboratory used by the FPD. The data gathered during this sampling program will be used in conjunction with data collected previously from the site such as RI data to perform the natural attenuation evaluation.

Table B-1 summarizes compounds detected in various environmental media sampled during the RI. As Table B-1 indicates, leachate and groundwater at the site contain a variety of aromatic, chlorinated-aromatic, and chlorinated-solvent compounds and their degradation products, which are the target organic analytes for evaluating natural attenuation. To assess natural attenuation, Tetra Tech will collect and analyze leachate and groundwater samples for target organic and geochemical indicator analytes. Target organic analytes are listed in EPA Contract Laboratory Program (CLP) SOW OLC02.1 and OLM03.2 (or their most current versions) for analyses of organics (EPA 1996a). Project-required quantitation limits (PRQL) for target organic analytes are presented in Table 3-1 of the QAPP. Target geochemical indicator analytes include conductivity; dissolved oxygen; temperature; pH; oxidation-reduction potential; alkalinity; ferrous iron; nitrate; sulfate; chloride; and methane, ethane, and ethene. For this assessment, Tetra Tech will also measure in the field methane, carbon dioxide, and oxygen in soil gas. Analytical methods for geochemical indicator analytes except ferrous iron are presented in the QAPP, Section 7.0, Table 7-1. Ferrous iron will be measured in the field using a colorimetric method (see Attachment B of this FSP). PRQLs for the geochemical indicator analytes are specified in the applicable EPA analytical methods and equipment manufacturer's instructions. PRQLs for methane, ethane, and ethene are described in Section 7.0 of the QAPP.

To assess analytical accuracy, Tetra Tech will collect split samples of soil, surface water, and sediment. PRQLs for the soil, surface water, and sediment split samples are the contract-required quantitation limits (CRQL) and contract-required detection limits (CRDL) specified in EPA CLP SOW OLM03.2 and ILM04.0 (or their most current versions) (EPA 1996a and 1996b). The PRQLs for soil, surface water, and sediment samples to be analyzed by FPD's laboratory are not established in the predesign QAPP (MW 1996). Analytical methods and PRQLs for samples to be split between EPA and FPD are expected to be comparable.

Analysis of target organic parameters will be used to assess whether there is a decreasing trend in target organic parameter concentrations. Analysis of geochemical indicator parameters will help assess qualitatively whether in situ degradation (natural attenuation) of the target organic parameters is occurring. Natural attenuation will be assessed in accordance with Proceedings of the Symposium of Natural Attenuation of Chlorinated Organics in Ground Water (EPA 1997) and Technical Protocol for Implementing Intrinsic Remediation with Long-term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater (AFCEE 1995). Following is a brief discussion of the information presented in these references.

Dissolved oxygen concentrations in leachate and groundwater will be compared to background conditions to help evaluate whether aerobic or anaerobic degradation is occurring. Also, if reduced nitrate and sulfate concentrations and elevated ferrous iron concentrations compared to background concentrations are observed, this trend will identify areas in leachate or groundwater where anaerobic degradation is occurring. This data may also imply that the analytes are being used as electron acceptors by naturally occurring bacteria to help mediate biological reactions of the target organic compounds, which act as electron donors and as a carbon source for the bacteria. Depressed pH in leachate and groundwater may be the result of organic acids generated as intermediate products of the oxidation of target organic compounds. Depressed oxidation reduction potential may indicate areas where leachate and groundwater degradation is occurring under reduced conditions. Elevated alkalinity concentrations may indicate areas of increased biodegradation as a result of the generation of carbon dioxide when target organic contaminants are degraded. The generation of ethene, ethane, and methane in leachate or groundwater may indicate the breakdown of chlorinated organic compounds such as tetrachloroethene and trichloroethene to vinyl chloride, which then may break down to ethene, ethane, and methane. Elevated chloride concentrations may indicate the dechlorination of chlorinated organic compounds. Also,

measuring methane, carbon dioxide, and oxygen in soil gas in shallow groundwater monitoring wells, and shallow and deep leachate vents will provide further indication to assess whether in situ biodegradation of target parameters is occurring. The presence of decreased oxygen concentrations and elevated methane and carbon dioxide concentrations may indicate anaerobic degradation, which has been shown in RI data (Warzyn 1994). To further evaluate the future performance of natural attenuation as a groundwater remedial action, Tetra Tech will use the analytical data presented in the RI report, analytical data collected during this field investigation, and the modeling approach described in Section 1.5 of the companion QAPP.

If FPD collects the leachate and groundwater samples for evaluating natural attenuation, Tetra Tech will collect four split groundwater samples. Tetra Tech will analyze the split samples for the target parameters in Table 1-1 of the QAPP to assess the FPD's laboratory's analytical accuracy. Tetra Tech will assess the FPD laboratory's analytical accuracy by comparing its split sample results to the FPD laboratory's sample results. Tetra Tech will also perform an independent evaluation of natural attenuation based on analytical results obtained by FPD. If Tetra Tech collects leachate and groundwater samples, Tetra Tech will coordinate its sampling program for assessing natural attenuation with the FPD.

#### **4.0 PROPOSED FIELD SAMPLING ACTIVITIES**

This section outlines proposed field sampling activities required by the EPA SOW under work plan Amendment No. 2 and agreed upon during teleconferences and meetings between EPA and Tetra Tech. All field activities will be conducted in accordance with the site-specific QAPP and Tetra Tech's field standard operating procedures (SOP), which are listed in Table B-2 and provided in Attachment A to this FSP. Where the FSP differs from the SOPs, the site-specific FSP will be followed.

The investigation at the site will include the following activities:

- Collecting groundwater samples from shallow and deep monitoring wells
- Collecting leachate samples from existing shallow and deep leachate vents
- Measuring pH, conductivity, temperature, dissolved oxygen, oxidation-reduction potential, and ferrous iron levels in groundwater and leachate samples in the field

**TABLE B-2**  
**FIELD STANDARD OPERATING PROCEDURES**

<b>SOP No.</b>	<b>Standard Operating Procedure</b>
002	General Equipment Decontamination
003	Organic Vapor Air Monitoring
008	Sampling Containerized Liquid, Sludge, and Slurry
010	Ground Water Sampling
014	Static Water Level, Total Well Depth, and Immiscible Layer Measurement
016	Sample Preservation and Maximum Holding Times
017	Sample Collection Container Requirements
018	Sample Custody
019	Packaging and Shipping Samples
024	Recording Notes in Field Logbook

Note:

SOP = Standard operating procedure

- Measuring methane, carbon dioxide, and oxygen levels in soil gas at shallow groundwater monitoring wells, and shallow and deep leachate vents in the field; soil gas present in the monitoring wells and leachate vents may be a byproduct of biodegradation and may migrate from adjacent soil pore spaces
- Collecting split samples of surface water, sediment, and soil

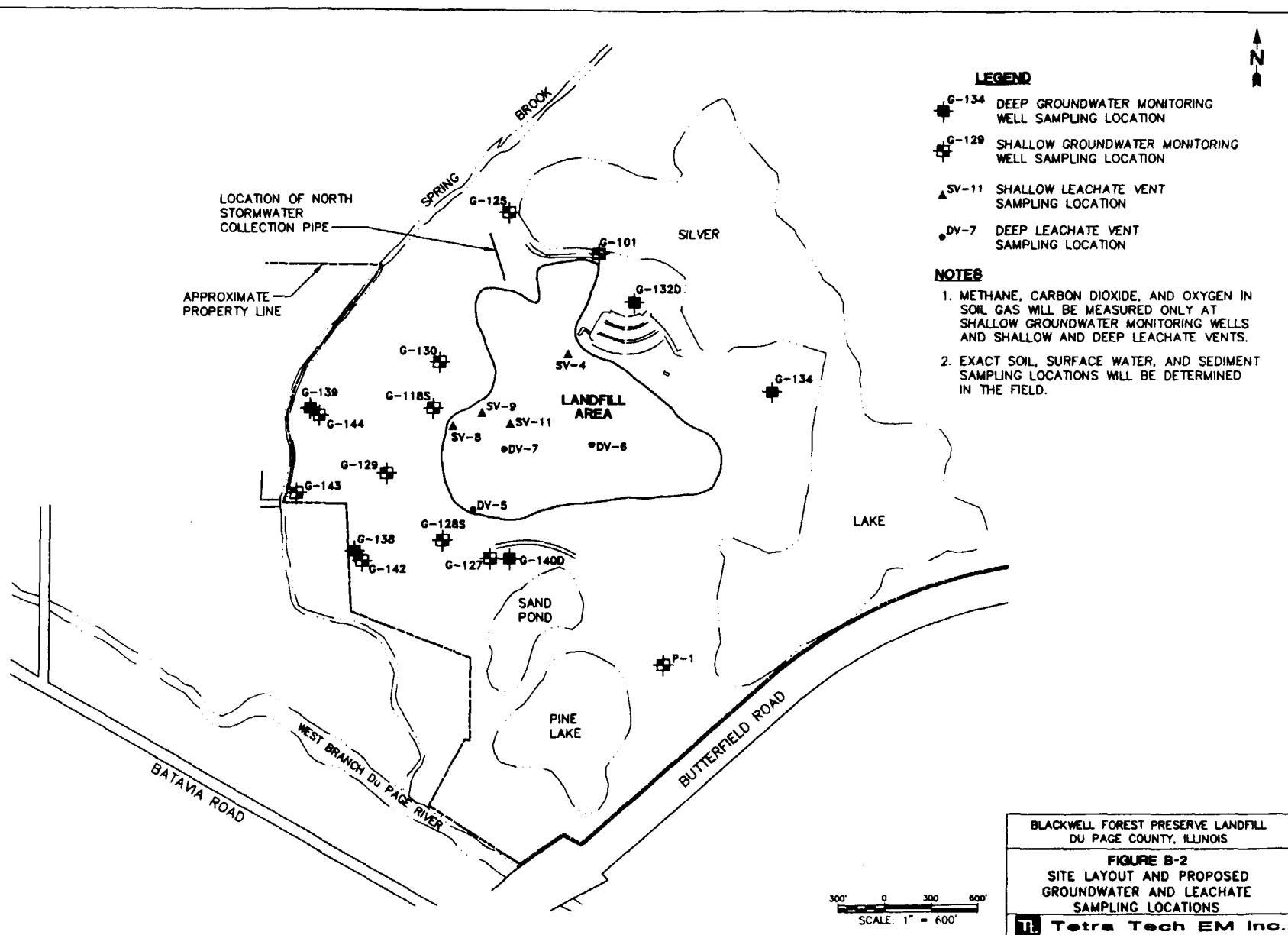
The proposed field investigation activities take into account all data from the RI described in Section 2.0 of the FSP. The proposed sampling locations are based on data from the RI but may be changed in the field based on site-specific visual observations and field screening results. Figure B-2 shows proposed groundwater and leachate sampling locations. Table B-3 summarizes the rationale for sampling location selection. Table B-4 indicates the specific parameters, analytes, laboratories, and intended data uses for each parameter. Table B-5 summarizes the sampling and analysis program for this project.

Tetra Tech will obtain permission from the FPD to use a portion of the site as a field support area for activities such as storing field equipment and supplies and for packaging samples. Pertinent data from the field investigation will be recorded in site logbooks in accordance with Tetra Tech's field SOP No. 024. Groundwater sampling activities, leachate sampling activities, soil gas field measurements, and split sampling activities are discussed below.

#### **4.1 GROUNDWATER SAMPLING ACTIVITIES**

Groundwater samples will be collected from shallow and deep monitoring wells around the landfill (see Figure B-2). The groundwater samples will be collected from purged monitoring wells and sampled using a low flow rate peristaltic pump. Purge water will be collected in 55-gallon drums and managed as discussed in Section 8.0 of the FSP. The low flow rate will minimize volatilization of VOCs and the drawing of fine-grained material into the monitoring well. The groundwater level in each well will be measured prior to purging and sampling in accordance with Tetra Tech's field SOP No. 014 to calculate the groundwater purge volume.

Geochemical indicator parameters, including pH, temperature, conductivity, oxidation-reduction potential, and dissolved oxygen, will be monitored in samples of purged groundwater, while purging the groundwater from the well and prior to sample collection. Geochemical indicator parameters (except ferrous iron) will be measured with an Aqua-Check Water Quality Analyzer. Manufacturer's instructions



**TABLE B-3**

**SAMPLING LOCATION RATIONALE**

Sampling Locations	Rationale
<b>Leachate Wells</b>	
SV-4, SV-8, SV-9, SV-11, DV-5, DV-6, DV-7	Leachate samples will be collected from these existing shallow and deep leachate vents to collect source data for contaminants detected in groundwater downgradient of the landfill.
<b>Shallow Groundwater Wells</b>	
G-118S, G-127, G-128S, G-129, G-130, G-142, G-143, G-144, P-1, G-101, G-125	<p>Groundwater samples will be collected from G-118S, G-127, G-128S, G-129, and G-130 because groundwater contamination was previously detected in these wells.</p> <p>Groundwater samples will be collected from G-142, G-143, and G-144 because these wells are newly installed to determine the extent of groundwater contamination downgradient from the landfill.</p> <p>Groundwater samples will be collected from P-1, G-101, and G-125 to determine background groundwater concentrations in the shallow aquifer.</p>
<b>Deep Groundwater Wells</b>	
G-132D, G-134, G-138, G-139, G-140D	<p>Groundwater samples will be collected from G-138, G-139, and G-140D because groundwater contaminants were previously detected in these wells.</p> <p>Groundwater samples will be collected from G-132D, and G-134 to determine background groundwater concentrations in the bedrock aquifer.</p>
<b>Soil</b>	
Four soil split samples will be collected from the north storm water pipe area at locations to be determined in the field.	Soil split samples will be collected from areas of visual contamination, areas with elevated field screening readings, or from just below the storm water pipe.
<b>Surface Water and Sediment</b>	
One surface water split and one sediment split sample will be collected from the northwest side of Sand Pond	The surface water and sediment split samples will be collected from sample locations proposed by FPD.



TABLE B-4

## PARAMETER, ANALYTE, LABORATORY, AND INTENDED DATA USE SUMMARY

Page 1 of 3

Parameter	Analyte	Laboratory	Intended Data Use
Groundwater			
Target <sup>a</sup>	Metals <sup>b</sup>	CLP	Groundwater samples will be analyzed to (1) assess whether natural attenuation of contaminants is occurring at the site, (2) associate contaminants detected in the landfill to contaminants detected in downgradient monitoring wells, and (3) estimate the rate of contaminant in situ biodegradation.
	VOCs and SVOCs <sup>c</sup>	CLP	
Geochemical Indicator	Conductivity	Field	Analytical data from four groundwater samples will also be used to perform a QC check of the analytical accuracy of the FPD laboratory.
	Dissolved oxygen	Field	
	Temperature	Field	
	pH	Field	
	ORP	Field	
	Ferrous iron	Field	
	Alkalinity	CRL	
	Nitrate	CRL	
	Sulfate	CRL	
	Chloride	CRL	
	CH <sub>4</sub> , ethane, and ethene	CRL	
Leachate			
Target	VOCs and SVOCs <sup>d</sup>	CLP	Leachate samples will be analyzed to (1) assess whether natural attenuation of contaminants is occurring at the site, (2) associate contaminants detected in the landfill to contaminants detected in downgradient monitoring wells, and (3) estimate the rate of contaminant in situ biodegradation
Geochemical Indicator	Conductivity	Field	
	Dissolved oxygen	Field	
	Temperature	Field	
	pH	Field	
	ORP	Field	
	Ferrous iron	Field	
	Alkalinity	CRL	

TABLE B-4

## PARAMETER, ANALYTE, LABORATORY, AND INTENDED DATA USE SUMMARY

Page 2 of 3

Parameter	Analyte	Laboratory	Intended Data Use
Leachate (Continued)			
Geochemical Indicator (Continued)	Nitrate	CRL	
	Sulfate	CRL	
	Chloride	CRL	
	CH <sub>4</sub> , ethane, and ethene	CRL	
Soil Gas			
Geochemical Indicator	CH <sub>4</sub>	Field	Soil gas samples will be analyzed to assess whether in situ degradation of contaminants is occurring at the site
	CO <sub>2</sub>	Field	
	O <sub>2</sub>	Field	
Soil, Sediment, and Surface Water			
Target	Metals <sup>b</sup>	CLP	Analytical data from the soil samples will be used to perform a QC check of the analytical accuracy of the FPD laboratory.
	VOCs and SVOCs <sup>d</sup>	CLP	

## Notes:

- CH<sub>4</sub> = Methane  
 CLP = Contract Laboratory Program  
 CO<sub>2</sub> = Carbon dioxide  
 CRL = Central Regional Laboratory  
 FPD = Forest Preserve District  
 O<sub>2</sub> = Oxygen  
 ORP = Oxidation-reduction potential  
 QC = Quality control  
 SVOC = Semivolatile organic compound  
 VOC = Volatile organic compound

All groundwater samples collected by Tetra Tech will be analyzed for VOCs and SVOCs. Four of these samples will be analyzed for metals. If FPD collects groundwater and leachate samples for evaluating natural attenuation, Tetra Tech will obtain four groundwater split samples and analyze them for VOCs, SVOCs, and metals.

**TABLE B-4**

**PARAMETER, ANALYTE, LABORATORY, AND INTENDED DATA USE SUMMARY**

Page 3 of 3

- <sup>b</sup> Target analytes are listed in the CLP SOW ILM04.0 (or its most current version) for metals.
- <sup>c</sup> Target analytes are listed in the CLP SOW OLC02.1 (or its most current version) for VOCs and SVOCs.
- <sup>d</sup> Target analytes are listed in the CLP SOW OLM03.2 (or its most current version) for VOCs and SVOCs.

**TABLE B-5**

**SAMPLING AND ANALYSIS PROGRAM**

Matrix	Field Parameter	Laboratory Parameter	No. of Investigative Samples	No. of Duplicate Samples <sup>a</sup>	No. of Equipment Blanks <sup>b</sup>	No. of Trip Blanks	No. of MS/MSD <sup>c</sup>	Total No. of Samples
Leachate	Geochemical indicator parameters <sup>d</sup>	VOC's, SVOC's, and geochemical indicator parameters <sup>d</sup>	7	1	1	1	1	11
Groundwater	Geochemical indicator parameters <sup>d</sup>	VOC's, SVOC's, metals <sup>e</sup> , and geochemical indicator parameters	16	2	2	2	1	23
Soil	None	VOC's, SVOC's, and metals	4	1	1	1	1	7
Surface Water	None	VOC's, SVOC's, and metals	1	1	0	1	1	4
Sediment	None	VOC's, SVOC's, and metals	1	1	1	0	0	3
Water IDW	None	VOC's, SVOC's, and metals	2	0	0	0	0	2

Notes:

IDW               =       Investigation-derived waste  
MS/MSD       =       Matrix spike/matrix spike duplicate  
SVOC           =       Semivolatile organic compound  
VOC            =       Volatile organic compound

- <sup>a</sup> Duplicates are collected at a rate of 1 per 10 or fewer investigative samples of the same matrix.
- <sup>b</sup> Equipment blanks will be rinsate samples run through sampling equipment and are collected at a rate of 1 per 10 or fewer investigative samples.
- <sup>c</sup> MS/MSD samples are collected at a rate of 1 per 20 or fewer investigative samples of the same matrix. MS/MSD soil samples are not considered to be additional samples.
- <sup>d</sup> Geochemical indicator parameters are listed in Table B-4.
- <sup>e</sup> Metals will be analyzed for in only four groundwater samples.

for the Aqua-Check Water Quality Analyzer are presented in Attachment B. After each well volume is purged, a sample of the purge water will be collected in a beaker. The probe from the Aqua-Check Water Quality Analyzer will then be inserted into the water in the beaker and the appropriate geochemical indicator parameter recorded in the field logbook. Ferrous iron concentrations in groundwater and leachate will be measured in the field using a HACH DR/820 colorimeter, following manufacturer's instructions (see Attachment B of the FSP).

Groundwater samples will be collected after pH, conductivity, and temperature stabilize to within  $\pm 10$  percent or three well volumes of groundwater have been purged, whichever occurs first. Geochemical indicator parameters (except ferrous iron) will be measured immediately upon sample collection with the Aqua-Check Water Quality Analyzer. Ferrous iron will also be measured as described above immediately upon sample collection. Groundwater level measurements and geochemical indicator data will be recorded in a field logbook in accordance with field SOP No. 024. The samples will be collected directly from the pump discharge hose and placed in the appropriate sample containers. A detailed description of groundwater sampling procedures is provided in Tetra Tech's field SOP No. 010. Samples will be collected for the following analyses in the following order: VOCs; ethene, ethane, and methane; SVOCs; nitrate; sulfate; chloride; alkalinity; and metals.

Groundwater samples for analysis of target organic and geochemical indicator analytes not measured on site will be shipped to a CLP laboratory or EPA Region 5 Central Regional Laboratory (CRL).

All equipment used to collect the groundwater samples will be decontaminated between sampling locations as described in Section 5.0 of this FSP and in Tetra Tech's field SOP No. 002.

If FPD collects groundwater samples for evaluating natural attenuation, Tetra Tech will provide oversight of the sampling event. Tetra Tech will obtain split samples from FPD, who will simultaneously fill its sample bottles along with Tetra Tech's sample bottles, as described in Section 4.4 of this FSP.

## **4.2 LEACHATE SAMPLING ACTIVITIES**

This activity will consist of collecting leachate samples from shallow and deep leachate vents within the landfill (see Figure B-2). The leachate samples from the vents will be collected in the same manner as the

groundwater samples. For example, three well volumes of the liquid in the leachate vents will be purged prior to sample collection.

The leachate samples will be analyzed by the CRL or CLP laboratory for VOCs, SVOCs, and geochemical indicator parameters not measured on site, including alkalinity; nitrate; sulfate; chloride; and methane, ethane, and ethene, following the same sampling order and procedures discussed in Section 4.1 for groundwater sample collection. As for groundwater, geochemical indicator data measured on site will be recorded in a field logbook in accordance with field SOP No. 024.

All equipment will be decontaminated between sampling locations as described in Section 5.0 of this FSP and Tetra Tech's field SOP No. 002.

If FPD collects leachate samples for evaluating natural attenuation, Tetra Tech will provide oversight of the sampling event. Tetra Tech does not anticipate obtaining leachate split samples from FPD.

#### **4.3 SOIL GAS FIELD MEASUREMENTS**

Soil gas in shallow groundwater monitoring wells, and shallow and deep leachate vents (see Figure B-2) will be monitored in the field for methane, carbon dioxide, and oxygen. A Landtec GA-90 Analyzer will be used to measure these geochemical indicator parameters in the field. Manufacturer's instructions for this analyzer are presented in Attachment B of this FSP. After opening the well or vent cover, each parameter will be immediately measured in soil gas with the analyzer at the top of well or vent casing, and its concentration will be recorded on site in a field logbook in accordance with field SOP No. 024. If soil gas concentrations at downgradient shallow monitoring wells are above background, the well will be left open for about one hour to purge stagnant gas and allow fresh soil gas to be produced into the well. After that time, the soil gas level of each parameter will again be measured and recorded in the field logbook. If soil gas measurements are still above background, then the gas in the well will be purged with an air pump. The air pump hose will be inserted to above the depth of the liquid in the well. The soil gas will be purged until field measurements are at least equal to background concentrations. The soil gas in the well will then be allowed to recharge for 3 to 4 hours. Methane, carbon dioxide, and oxygen levels in the soil gas in the well will then be recorded in the field logbook in accordance with field SOP No. 024.

If methane levels exceed acceptable lower explosive limit levels specified in the project-specific health and safety plan (HSP), the appropriate corrective actions discussed in the HSP will be implemented. If FPD performs soil gas field measurements, Tetra Tech will provide oversight of the measurement activities.

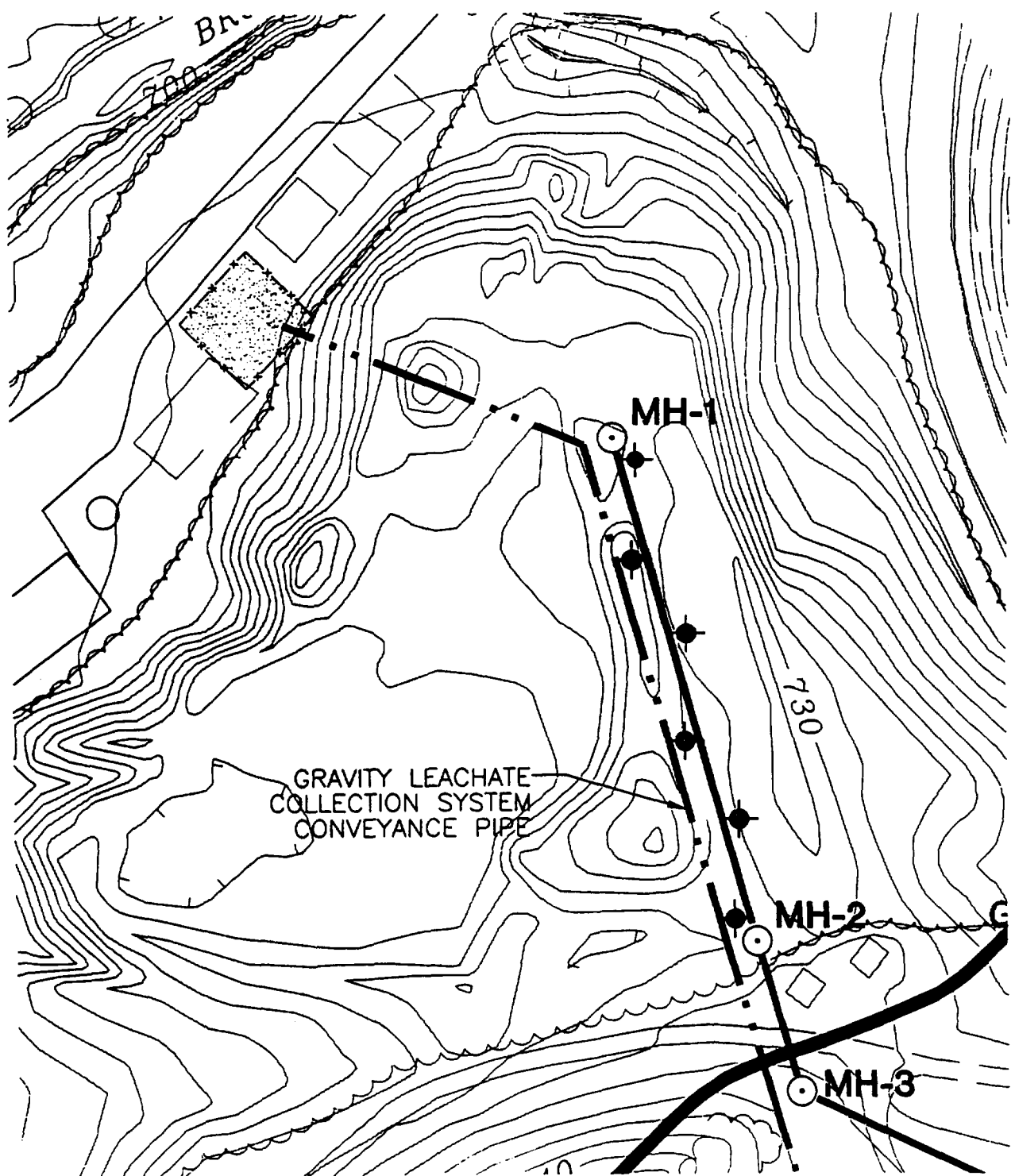
#### **4.4 SPLIT SAMPLING ACTIVITIES**

Tetra Tech will obtain from FPD split samples of soil, sediment, and surface water. Analytical results from these samples will be used to perform a QC check of the laboratory used by FPD to analyze the samples. One surface water split sample and one sediment split sample will be collected from Sand Pond on the south side of the landfill from locations to be determined in the field. Four soil split samples will be collected from soil sampling locations proposed by FPD near the storm water collection pipe on the north side of the landfill (see Figure B-3). Exact soil split sampling locations have not yet been determined; this determination will be made by Tetra Tech in the field based on (1) field screening results, (2) visual evidence of contamination, and (3) representativeness of surface and subsurface conditions.

FPD will collect all soil, sediment, and surface water investigative samples. Tetra Tech will provide oversight of the sampling event and will obtain split samples from FPD, who will simultaneously fill its sample bottles along with Tetra Tech's. Tetra Tech's samples of these media will be analyzed by a CLP laboratory for VOCs, SVOCs, and metals.

#### **5.0 DECONTAMINATION PROCEDURES**

A decontamination area will be temporarily constructed in the maintenance area of the forest preserve. Sampling equipment will be decontaminated in buckets and drums placed on plastic liners in the maintenance area. All sampling equipment will be decontaminated prior to use at each sampling location. Decontamination will consist of removing all visible evidence of contamination using Alconox<sup>®</sup> soap and water and rinsing the sampling equipment with distilled water. The decontaminated equipment will then be allowed to air dry. The groundwater pump will be decontaminated by pumping Alconox<sup>®</sup> soap and water through the pump until soap is observed discharging from the hose. Clean tap water will then be pumped through the pump and hose to remove the soap. Finally, distilled water will be pumped through the pump and hose to remove the tap water. Decontamination procedures are discussed in further detail in Tetra Tech's field SOP No. 002. Disposable equipment, such as plastic tubing from the

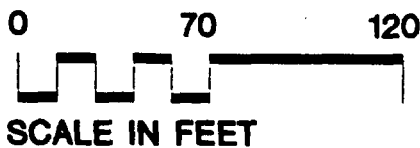


GRAVITY LEACHATE  
COLLECTION SYSTEM  
CONVEYANCE PIPE

MH-1

MH-2

MH-3



**LEGEND**

• PROPOSED SOIL BORING LOCATION

BLACKWELL FOREST PRESERVE LANDFILL  
DU PAGE COUNTY, ILLINOIS

**FIGURE B-3**  
NORTH STORMWATER COLLECTION PIPE  
SOIL SAMPLING LOCATIONS

**Tetra Tech EM Inc.**

SOURCE: MODIFIED FROM MONTGOMERY WATSON 1997a



peristaltic pump, coveralls, gloves, and boot covers, will be used whenever possible to minimize the possibility of cross contamination. Decontamination fluids will be collected and stored in 55-gallon drums as described in Section 8.0 of the FSP.

## **6.0 SAMPLE HANDLING PROCEDURES**

Tetra Tech will obtain samples of groundwater, leachate, surface water, soil, and sediment from the appropriate locations (see Section 4.0); preserve and prepare these samples for shipment; and complete all necessary paperwork. Sample containers, sample preservation and preparation, sample identification and documentation, sample chain-of-custody procedures, and sample packaging and shipping procedures are discussed below.

### **6.1 SAMPLE CONTAINERS**

Contaminant-free containers to be used for samples undergoing inorganic and organic analyses will be prepared in accordance with the procedures specified in EPA's "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers" (EPA 1992). Specifications for the containers will be verified by Tetra Tech by checking the supplier's certified statement and analytical results for each container lot. These activities will be documented on a continuing basis and the documents will be maintained in the project evidence file. Sample container requirements are summarized in Table B-6 and described in detail in Tetra Tech field SOP No. 017.

### **6.2 SAMPLE PRESERVATION AND PREPARATION**

All samples will be preserved as necessary and shipped to the appropriate laboratories by overnight express carrier on the day of collection. Sample preservation, preparation, and maximum holding times are summarized in Table B-6 and described in detail in Tetra Tech field SOP No. 016.

### **6.3 SAMPLE IDENTIFICATION AND DOCUMENTATION**

Each sample will be designated using a three-component alphanumeric system identifying the project, sample identifier, sampling location, and sampling depth (for soil samples). The project

TABLE B-6

## SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Page 1 of 2

Analytical Parameter	Number of Containers Per Sample	Container Type	Preservation Method	Holding Time
<b>Leachate, Groundwater, and Surface Water Samples<sup>a</sup></b>				
Metals	One	1-liter polyethylene bottle	Cool to 4 °C; adjust pH to <2 with HNO <sub>3</sub>	6 months
VOCs	Two	40- mL vials with Teflon®-lined septum caps	4 drops concentrated HCl; Cool to 4 °C	14 days
SVOCs	One	80-ounce amber glass bottle with Teflon®- lined cap	Cool to 4 °C	Extract within 7 days; analyze extract within 40 days
Alkalinity	One	500-mL plastic bottle with Teflon®-lined cap	Cool to 4 °C	Within 24 hours of sample receipt by the laboratory
Nitrate	One	500-mL plastic bottle with Teflon®-lined cap	Cool to 4 °C; adjust pH to <2 with H <sub>2</sub> SO <sub>4</sub>	Within 24 hours of sample receipt by the laboratory
Sulfate	One	500-mL plastic bottle with Teflon®-lined cap	Cool to 4 °C	14 days
Chloride	One	500-mL plastic bottle with Teflon®-lined cap	Cool to 4 °C	14 days
Methane, Ethane, and Ethene	Two	40-mL with Teflon®- lined septum caps	4 drops concentrated HCl; Cool to 4 °C	14 days

**TABLE B-6**

**SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES**

Page 2 of 2

Analytical Parameter	Number of Containers Per Sample	Container Type	Preservation Method	Holding Time
Soil and Sediment Samples				
Metals	One	8-ounce, widemouth glass jar with Teflon®-lined cap	Cool to 4°C	6 months
VOCs	One	4-ounce, widemouth glass jar with Teflon®-lined cap	Cool to 4°C	14 days
SVOCs	One	8-ounce, widemouth glass jar with Teflon®-lined cap	Cool to 4°C	14 days

**Notes:**

°C	=	Degree Celsius
HCl	=	Hydrochloric acid
HNO <sub>3</sub>	=	Nitric acid
H <sub>2</sub> SO <sub>4</sub>	=	Sulfuric acid
mL	=	Milliliter
SVOC	=	Semivolatile organic compound
VOC	=	Volatile organic compound

\* Surface water samples will only be analyzed for VOCs, SVOCs, and metals.

designation will be "BL" for the Blackwell site. Each sample will be identified by a two-character alphabetic code corresponding to the type of sample as follows: "LW" for a leachate sample obtained from a shallow or deep leachate vent, "GW" for a groundwater sample obtained from a monitoring well, "SS" for a soil split sample obtained from a soil boring, "SW" for a surface water split sample obtained from Sand Pond, and "SD" for a sediment split sample obtained from Sand Pond.

Each leachate or groundwater sampling location will have up to a six-digit numeric designation. The six-digit numeric designation will follow the sample type alphabetic code to specify the well or vent from which the sample was collected. This number may be followed by a one-character alphabetic identifier to indicate a duplicate sample (D). Field blanks from groundwater sampling will be designated with "FB." Equipment rinsate blanks from decontaminating sampling equipment will be designated with "ER." Trip blanks will be designated with "TB." Matrix spike/matrix spike duplicate (MS/MSD) samples will be identified in the field logbook and clearly designated on the chain-of-custody forms rather than in the sample identification numbers. Examples of leachate, groundwater, and soil sample numbers are listed below.

- BL-LW-SV11D Blackwell site, leachate sample from shallow vent SV-11, duplicate
- BL-GW-MW145 Blackwell site, groundwater sample from monitoring well 145
- BL-SS-SB-0215 Blackwell site, soil split sample from soil boring 02 collected at a depth of 15 feet bgs

Sampling activities will be documented in a bound logbook using a ballpoint pen in accordance with Tetra Tech's field SOP No. 024. The time of collection, sample number, sampling location, field observations, sampler's name, analyses, and sampling depth interval (if applicable) will be recorded in the logbook for each sample. Each page of the logbook will be dated, numbered, and signed by Tetra Tech personnel. Field data records will be maintained in accordance with National Enforcement Investigation Center Policies and Procedures (EPA 1985).

#### 6.4

#### SAMPLE CHAIN-OF-CUSTODY PROCEDURES

All samples will be collected and handled using proper chain-of-custody procedures as outlined in Tetra Tech field SOP No. 018. When collecting samples for laboratory analysis, field personnel will complete the standard EPA Region 5 laboratory paperwork used for tracking samples, including the following information:

- Inorganic traffic reports
- Organic traffic reports
- Chain-of-custody forms
- Sample tags
- Custody seals

Tetra Tech will follow the procedures in the EPA Region 5 "SARA/Superfund Sample Handling Manual" (EPA 1989) to complete the documentation forms listed above.

Tetra Tech will appoint a sample custodian. Upon completion of all required documents, the sample custodian will sign and date the documents and list the time of sample collection. The custodian will also confirm the completeness of all descriptive information on the chain-of-custody forms, which will be included with each shipping container. One custody seal will be placed across the latch of the container, and another seal will be placed on one side of the lid. The lid will be securely taped shut for shipment. The sample custodian will retain the pink copies of all chain-of-custody forms for Blackwell site project files.

#### 6.5

#### SAMPLE PACKAGING AND SHIPPING PROCEDURES

All environmental samples collected for chemical analysis will be shipped on the day of collection using an overnight delivery service. Sample containers will be placed in plastic bags in case the containers break during shipment. The sample containers will then be placed in coolers filled with a cushioning packing material such as vermiculite. Ice that has been double bagged will then be placed in the coolers to maintain the temperature of the samples at 4 °C or lower during transport. Laboratory paperwork for the

samples will be placed in a sealed plastic bag and taped to the inside of the cooler lid. The cooler lid will then be taped closed and chain-of-custody seals placed on the cooler lid. All groundwater samples for chemical analysis will be packaged and shipped as low-concentration samples in accordance with specified CLP procedures. All leachate, soil, sediment, and surface water samples for chemical analysis will be packaged and shipped as medium-concentration samples (EPA 1988). All shipping containers will be labeled as required by the U.S. Department of Transportation. Sample packaging and shipping procedures are discussed in detail in Tetra Tech field SOP No. 019.

After packaging, the samples will be shipped by overnight carrier to the designated laboratories determined by the EPA regional sample control coordinator (RSCC). Tetra Tech field technical staff and the sample coordinator from the Tetra Tech Chicago office will coordinate with the RSCC to obtain laboratories for the planned analyses.

## **7.0 TENTATIVE SCHEDULE FOR FIELD ACTIVITIES**

The following is a tentative schedule for all field activities:

- Completion of FSP: January 22, 1998, for draft; February 21, 1998, for final
- Field support and mobilization: March 2, 1998
- Collection of leachate and groundwater samples, and split surface water, split sediment, and split soil samples: March 3 through 13, 1998
- Site demobilization: March 14, 1998

## **8.0 DISPOSAL OF INVESTIGATION-DERIVED WASTE**

All decontamination fluids and groundwater purged prior to sampling will be collected, placed in 55-gallon drums, and labeled "Decontamination Fluids" and "Groundwater," respectively. Purged groundwater will be transported from the groundwater monitoring well location to a designated storage area at the end of each working day. Other wastes, such as personal protective equipment and disposable equipment, will be double-bagged and placed in steel 55-gallon drums in the storage area. IDW will be stored on site near the maintenance area.

Two liquid IDW samples will be collected in accordance with Tetra Tech field SOP No. 008 and analyzed for VOCs, SVOCs, and metals to determine the appropriate disposal method for the IDW (see Table B-5). It is anticipated that the liquid IDW will be disposed of at the Wheaton Wastewater Treatment Plant along with leachate collected as part of operation and maintenance of the LCS. Liquid IDW was disposed of at this location during the RI (Warzyn 1994).

## **9.0 HEALTH AND SAFETY PROCEDURES**

All field activities will be conducted in accordance with the site-specific HSP which is part of the site-specific plans for this WA. Prior to the initiation of field activities, all field personnel will read and sign the HSP to indicate that they understand the plan and agree to operate in accordance with its requirements. A copy of the site-specific plans, including the HSP, will be kept at the field support area at the Blackwell site.

## **10.0 QUALITY ASSURANCE REQUIREMENTS**

QA/QC requirements for the field investigation are described in the QAPP, which is Appendix A of the SAP. A copy of the QAPP will be kept at the field support area at the site for immediate use in resolving QA issues that arise during field activities.

## 11.0 REFERENCES

- Air Force Center for Environmental Excellence (AFCEE). 1995. "Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater." Revision 0. November 11.
- Montgomery Watson, Inc. (MW). 1996. "Quality Assurance Project Plan Pre-Design Investigation Activities." August.
- MW. 1997a. "Revised Addenda to Sampling Plans, Proposed Investigation of North Storm Water Pipe, and Surface Water Sampling of Sand Pond." December 4.
- MW. 1997b. "Expedited Work Plan and Prefinal Design for Leachate Collection System Response Action." February.
- U.S. Environmental Protection Agency (EPA). 1985. "National Enforcement Investigation Center (NEIC) Policies and Procedures." EPA-330/9-78/001-R. Revised June.
- EPA. 1988. "Users Guide to the Contract Laboratory Program." EPA Document No. 9240.0-1.
- EPA. 1989. "SARA/Superfund Sample Handling Manual." Region 5 Central Regional Laboratory. March.
- EPA. 1991. Drinking Water Regulations and Health Advisories. EPA 822-B-96-002. November.
- EPA. 1992. "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers." April.
- EPA. 1996a. Contract Laboratory Program (CLP) Statement of Work for Organic Analysis, Low Concentration Water OLC02.1 and Multi-Media Multi-Concentration OLM03.2. February.
- EPA. 1996b. CLP Statement of Work for Inorganic Analysis, Multi-Media Multi-Concentration ILM 04.0.
- EPA. 1997. "Proceedings of the Symposium on Natural Attenuation of Chlorinated Organics in Ground Water." EPA/540/R-97/504. May.
- U.S. Geological Survey (USGS). 1980. 7.5-Minute Topographic Map of Naperville, Illinois, Quadrangle.
- Warzyn, Inc. (Warzyn). 1994. "Final Remedial Investigation Report for the Blackwell Landfill NPL Site." December 1994.



**ATTACHMENT A**  
**TETRA TECH EM INC. FIELD STANDARD OPERATING PROCEDURES**  
**(284 Sheets)**

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**GENERAL EQUIPMENT DECONTAMINATION**

**SOP NO. 002**

**REVISION NO. 2**

Approved by:

Daniel Ashenberg  
Quality Assurance Officer

2/2/93  
Date

Date of Original Issue: 03/31/91

Title: General Equipment Decontamination

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## **1.0 BACKGROUND**

All nondisposable sampling, personnel, and well drilling and monitoring equipment must be cleaned before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross contamination.

### **1.1 PURPOSE**

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating general equipment in the field.

### **1.2 SCOPE**

This SOP applies to decontaminating general nondisposable equipment. To prevent contamination of samples, all sampling equipment must be thoroughly cleaned prior to each use.

### **1.3 DEFINITIONS**

Alconox or Liquinox -- nonphosphate soaps

### **1.4 REFERENCES**

U.S. Environmental Protection Agency, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, pages 106-107.

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## **1.5 REQUIREMENTS AND RESOURCES**

The following equipment is required for decontamination:

- Scrub brushes
- Long-bristle brushes
- Large wash tubs or buckets
- Alconox or Liquinox
- Tap water
- Distilled water
- Steam cleaner
- Aluminum foil
- Plastic bags
- Plastic sheeting
- Methanol, hexane, or isopropanol, if necessary
- Nitric acid, if necessary
- Drums or containers for decontamination water

## **2.0 PROCEDURE**

This procedure applies to decontaminating all nondisposable personnel, drilling, monitoring, and sampling equipment.

### **2.1 DECONTAMINATING PERSONNEL EQUIPMENT**

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off site or to clean areas. All used disposable protective clothing, such as Tyvek® coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums. Personnel

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decontamination procedures will be modified based on the level of protection required. The decontamination procedures outlined below are applicable to personnel working in Level D.

Personnel decontamination procedures will be as follows:

1. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean tap water. Remove booties and retain boots for subsequent reuse.
2. Wash outer gloves in Liquinox or Alconox solution and rinse in clean tap water. Remove outer gloves and place into plastic bag for disposal.
3. Remove Tyvek® or coveralls. Containerize Tyvek® for disposal and place coveralls in plastic bag for reuse.
4. Remove air purifying respirator (APR), if used, and place spent filters in a plastic bag for disposal. Filters should be changed at least daily depending on use and application. Wash entire mask in clean warm water or disinfect with APR wipes at the end of each day. Place respirator in a separate plastic bag after cleaning and disinfecting.
5. Remove disposable gloves and place them in plastic bag for disposal.
6. Thoroughly wash hands and face with clean tap water and facial soap.

## **2.2 DECONTAMINATING DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT**

All drilling equipment should be decontaminated at a designated location on site before drilling begins, between borings, and at project completion.

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Monitoring well casings, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they should be steam cleaned on site prior to placement downhole. The drilling subcontractor will furnish the steam cleaner and water.

After cleaning the drilling equipment, field personnel should place the drilling equipment, well casings, screens, and any other equipment that will go into the hole on clean polyethylene sheeting.

The drilling auger, bits, drill pipe, temporary casing, surface casing, and other equipment should be decontaminated by the drilling subcontractor by hosing them down with a steam cleaner until thoroughly clean. Drill bits and tools that still exhibit particles of soil after the first washing should be scrubbed with a wire brush and rinsed again with a high-pressure steam rinse.

All wastewater from decontamination procedures should be collected in 55-gallon drums or similar containers.

### 2.3 DECONTAMINATING SOIL SAMPLING EQUIPMENT

Soil sampling and groundwater sampling equipment should be decontaminated after each use as follows:

1. Prior to sampling, scrub the split-barrel sampler, sampling tools, and bailers in a bucket using a stiff, long-bristle brush and Liquinox or Alconox solution.
2. Clean sampling equipment over the rinsate tub with distilled water and allow it to air dry. If convenient, bailers and split-barrel samplers may be thoroughly steam cleaned at a designated decontamination station rather than being washed by hand.
3. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.

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4. Containerize all water and rinsate.
5. Decontaminate all temporary well material and pipes placed down the hole as described for drilling equipment.

## **2.4 DECONTAMINATING WATER-LEVEL MEASUREMENT EQUIPMENT**

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing from each well. The following decontamination procedures should be used:

1. Wipe the sounding cable with a disposable soap-impregnated cloth or paper towel.
2. Rinse with deionized, organic-free water.

## **2.5 DECONTAMINATING GENERAL SAMPLING EQUIPMENT**

All nondisposable sampling equipment must be decontaminated using the following procedures:

1. Select an area downwind and downgradient from sampling locations to avoid cross contamination between sampling points.
2. Maintain the same level of protection as was used for sampling.
3. To decontaminate a piece of equipment: use an Alconox or Liquinox wash; a tap water wash; a solvent rinse (methanol, hexane, or isopropanol), if applicable, or a dilute (0.1N) nitric acid rinse, if applicable; and a distilled water rinse. Allow to air dry. Use a methanol, hexane, or isopropanol rinse for grossly contaminated equipment (for example, equipment that is not readily cleaned by the Alconox wash).
4. Place cleaned equipment in a clean area on plastic sheeting and wrap with aluminum foil.
5. Containerize all water and rinsate.

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**ORGANIC VAPOR AIR MONITORING**

**SOP NO. 003**

**REVISION NO. 0**

Approved by:

*Ronald Presing*  
Quality Assurance Officer

4/8/94  
Date



## **1.0 BACKGROUND**

Exposure to airborne organic contaminants can present a significant threat to worker health and safety. Identifying and quantifying these contaminants through air monitoring is essential for reconnaissance activities. Reliable measurements of airborne organic contaminants are necessary for selecting personal protective equipment, delineating areas where protection is needed, assessing the potential health effects of exposure, and determining the need for specific medical monitoring.

### **1.1 PURPOSE**

This standard operating procedure (SOP) discusses factors to consider when conducting organic vapor air monitoring.

### **1.2 SCOPE**

This SOP discusses procedures, instruments, and variables affecting outdoor monitoring for assessing airborne organic vapor contamination. The instrument manuals, which outline the procedures for use of an HNu® photoionization detector (PID) and a Foxboro® organic vapor analyzer (OVA) flame ionization detector (FID), are included in Appendices A and B, respectively.

### **1.3 DEFINITIONS**

**Flame Ionization** – A process by which a sample gas is ionized with a flame allowing a count of carbon atoms to determine organic vapor concentration

**Flame Ionization Detector (FID)** – A portable instrument used to detect, measure, and provide a direct reading of organic vapor concentrations by which a sample gas is ionized with a flame allowing a count of carbon atoms

**Ionization Potential** – The amount of energy needed to strip an electron from the orbit of its resident molecule, expressed in electron volts

**Organic Vapor** – Airborne compounds composed of carbon, hydrogen, and other elements with chain or ring structures

**Organic Vapor Analyzer (OVA)** – A portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of trace organic gases in the atmosphere through flame ionization

**Photoionization** – A process involving the absorption of ultraviolet light by a gaseous molecule, leading to ionization

**Photoionization Detector (PID)** – A portable instrument used to detect, measure, and provide a direct reading of the concentrations of a variety of trace organic gases in the atmosphere through photoionization

#### 1.4 REFERENCES

NIOSH/OSHA/USCG/EPA. 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." U.S. Government Printing Office. Washington, DC.

## **1.5 REQUIREMENTS AND RESOURCES**

The equipment used to conduct direct reading monitoring of airborne organic compounds consists of an HNu® PID and a Foxboro® OVA FID. Other equipment such as a microtip PID is available to conduct similar air monitoring. Calibration gas is also required.

## **2.0 PROCEDURES**

The following subsections present a detailed discussion of direct-reading instrument constraints, accurate recording and interpretation of instruments, the HNu® PID, and the OVA FID.

### **2.1 DIRECT-READING INSTRUMENT CONSTRAINTS**

All direct-reading instruments have inherent constraints in their ability to detect gaseous organic compounds. They usually detect and/or measure only specific classes of chemicals. Generally, they are not designed to measure and/or detect airborne concentrations below 1 part per million (ppm). Finally, many direct reading instruments that have been designed to detect one particular substance also detect other substances, causing interference and possibly resulting in false readings.

### **2.2 ACCURATE RECORDING AND INTERPRETATION**

Direct-reading instruments must be operated and the data interpreted by individuals who understand the operating principles and limitations of the instruments. At hazardous waste sites where unknown and multiple contaminants are frequently encountered, instrument readings should be interpreted conservatively.

The following guidelines promote accurate recording and interpretation:

- Calibrate instruments in accordance with the manufacturer's instructions before and after every use.
- The instrument's readings have limited reliability when specific organic contaminants are unknown. When recording readings of unknown contaminants, report them as "X" instrument units or as a "positive response" rather than in specific concentrations in measured units such as ppm.
- Conduct additional monitoring at any location where a positive response occurs.
- Report a reading of zero as nondetectable (ND) rather than as "clean". Quantities of chemicals may be present but at concentrations that are not detectable by the instrument.
- Repeat the air monitoring survey using other detection devices.

## **2.3 HNu® PHOTOIONIZATION DETECTOR**

The following subsections discuss the procedures for use, application, detection method, limitations, general care and maintenance, and typical operating time of the HNu® PID.

### **2.3.1 Procedures for Use**

The procedures for using the HNu® PID is explained in the instruction manual in Appendix A of this SOP.

### **2.3.2 Application**

The HNu® PID can be used to detect total concentrations of many organic and some inorganic gases and vapors. It can also be used in conjunction with other detection devices such as colorimetric indicator detector tubes, to identify specific compounds.

### **2.3.3 Detection Method**

The HNu® PID ionizes molecules using ultraviolet (UV) radiation. The radiation strips electrons from the molecules, producing ions that produce a current proportional to the number of ions generated. The HNu® PID is more sensitive to aromatics and unsaturated compounds than the Foxboro® OVA FID. The PID is nonspecific for gas and vapor detection for organics and some inorganics. The PID is also sensitive to 0.1 ppm of benzene. Sensitivity is related to the ionization potential of the compound being monitored.

### **2.3.4 Limitations**

The HNu® PID cannot be used to:

- Detect methane
- Detect a compound that has a lower energy level than the ionization potential of the PID
- Respond accurately to a mixture of gases or vapors
- Respond accurately in high humidity or very cold weather
- Respond accurately when interference from other sources is present

### **2.3.5 General Care and Maintenance**

The HNu® PID needs to be recharged every 10 hours or have its battery replaced. The lamp window in the probe must be cleaned regularly. The instrument and its accessories must also be regularly cleaned and maintained.

### **2.3.6 Typical Operating Time**

The HNu® PID can run for 10 hours on a charged battery or 5 hours with a strip chart recorder. The battery needs to be recharged for 14 hours; therefore, additional batteries are recommended when conducting field work.

## **2.4 FOXBORO® ORGANIC VAPOR ANALYZER FLAME IONIZATION DETECTOR**

The following subsections discuss the application, detection method, limitations, general care and maintenance, and typical operating time of the Foxboro® OVA FID.

### **2.4.1 Procedures for Use**

The procedures for using the Foxboro® OVA FID is explained in the instruction manual in Appendix B of this SOP.

### **2.4.2 Application**

When set in the survey mode, the OVA FID can detect the total concentration of many organic gases and vapors. In the gas chromatography (GC) mode, the OVA FID can identify and measure the

concentrations of specific compounds. In the survey mode, all organic compounds are ionized and detected at the same time. In the GC mode, volatile species are ionized and detected separately.

#### **2.4.3 Detection Method**

Organic gases and vapors are flame ionized in the OVA FID. The ions produce a current that is proportional to the number of carbon atoms present. This is then interpreted by a deflection on the instrument's meter. In the survey mode, the FID functions as a nonspecific total hydrocarbon analyzer. While in the gas chromatograph mode, the FID provides a tentative qualitative and quantitative identification of gases and vapors. The FID is most sensitive to saturated hydrocarbons, alkanes, and unsaturated hydrocarbon alkanes. The FID is not suitable for inorganic gases such as chloride, hydrogen cyanide, and ammonia. The FID is also less sensitive to aromatics and unsaturated compounds than the HNu® PID. Gases and vapors that contain substituted function groups such as hydroxide (OH<sup>-</sup>) reduce the detector's sensitivity. Finally, if the operator monitors for a specific gas or vapor, the operator should know the chemical standard and calibration column for that particular gas or vapor.

#### **2.4.4 Limitations**

The OVA FID has the following limitations:

- Detection of inorganics and some synthetic gases and vapors because sensitivity depends on the compounds measured
- Detection of organics and inorganics in ambient temperatures of less than 40° F (4° C)
- Identification of specific compounds with the OVA FID because of varying ambient conditions such as temperature and humidity

- Identification of organics or inorganics in high concentrations or in an oxygen-deficient atmosphere because the instrument would require modifications; therefore, the OVA FID may detect inaccurate readings
- Detecting organic or inorganics in the survey mode, readings can be only reported relative to the calibration standard used, such as methane equivalents
- Identification of a specific contaminant because the OVA FID must be calibrated with that specific contaminant

#### **2.4.5 General Care and Maintenance**

The hydrogen fuel supply must be monitored during use to maintain an adequate supply. Also, the OVA FID user should perform routine maintenance procedures described in the instruction manual in Appendix B of this SOP and routinely check the OVA FID for leaks.

#### **2.4.6 Typical Operating Time**

The OVA FID can typically run continuously for 8 hours on a fully charged battery or 3 hours with a strip chart recorder. The OVA FID battery must be recharged every 8 hours or replaced, as needed.

### **3.0 VARIABLES AFFECTING OUTDOOR AIR MONITORING**

Complex environments containing many substances such as those associated with hazardous waste sites pose significant challenges to accurately and safely assess airborne contaminants. Several independent and uncontrollable variables (most notably temperature and weather conditions) can affect airborne concentrations. These factors must be considered when conducting air monitoring and interpreting data. The following environmental variables must be considered:



- **Temperature** – An increase in temperature increases the vapor pressure of most chemicals.
- **Wind Speed** – An increase in wind speed can affect vapor concentration near a free-standing liquid surface. Dust and particulate-bound contaminants are also affected.
- **Rainfall** – Water from rainfall can essentially cap or plug vapor emission routes from open or closed containers, saturated soil, or lagoons, thereby reducing airborne emissions of certain substances.
- **Moisture** – Dusts, including finely divided hazardous solids, are highly sensitive to moisture. Moisture can vary significantly with respect to location and time and can also affect the accuracy of many sampling results.
- **Vapor Emissions** – The physical displacement of saturated vapors can produce short-term, relatively high vapor concentrations. Continuing evaporation and/or diffusion may produce long-term vapor concentrations and may involve large areas.
- **Work Activities** – Work activities often require the mechanical disturbance of contaminated materials, which may change the concentration and composition of airborne contaminants and contribute to airborne emissions from gasoline or diesel engine emissions.

These conditions should be reported with the OVA FID meter readings to provide an accurate interpretation of monitoring results.

**APPENDIX A**  
**INSTRUCTION MANUAL**  
**FOR THE HNU® PHOTOIONIZATION DETECTOR**

**(37 Pages)**

# INSTRUCTION MANUAL HW-101



**tenu**  
**MODEL HW-101**  
**Portable Hazardous Waste Analyzer**

Preliminary Version  
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Published in the U.S.A.



UNIT MODEL AND SPECIFICATION SHEET

Serial # 970139

Calibrations: Benzene

By: A.L.

Range: 0-10, 0-100, 0-1000 Span Pot Setting: 9.8

Light Source Energy: 9.5eV 10.2eV R666 11.7eV

REFERENCE GAS DATA

Species	Concentration (ppm)	Span Pot	Response (ppm)
		9.8	102.0
		-	56.0
		-	58.0

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## **SAFETY SUMMARY**

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

### **KEEP AWAY FROM LIVE CIRCUITS**

Operating personnel must at all times observe all safety regulations. Do not replace components or make any adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the OFF position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

### **DO NOT SERVICE OR ADJUST ALONE**

Under no circumstances should any person reach into the equipment for the purpose of servicing or adjusting except in the presence of someone who is capable of rendering aid.

### **RESUSCITATION**

Personnel working with or near high voltage should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

The following warnings appear in the text in this volume, and are repeated here for emphasis.

**WARNINGS:** Do not observe the light source closer than 6 inches. When necessary, observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

A high reading on the meter should be cause for protective action since the instrument measures gases in the vicinity of the operator.



Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltages of -1200 VDC, will be present.

Use great care when operating the analyzer with the readout assembly outside the case due to the presence of -1200 V DC.

When conducting tests on analyzer in open condition, exercise great care due to presence of high voltage.

## CHAPTER 1

### GENERAL INFORMATION AND SAFETY PRECAUTIONS

#### 1-1 SAFETY PRECAUTIONS

Safety precautions to be exercised in the use and repair of this equipment are described in the Safety Summary in the front section of this manual.

#### 1-2 INTRODUCTION

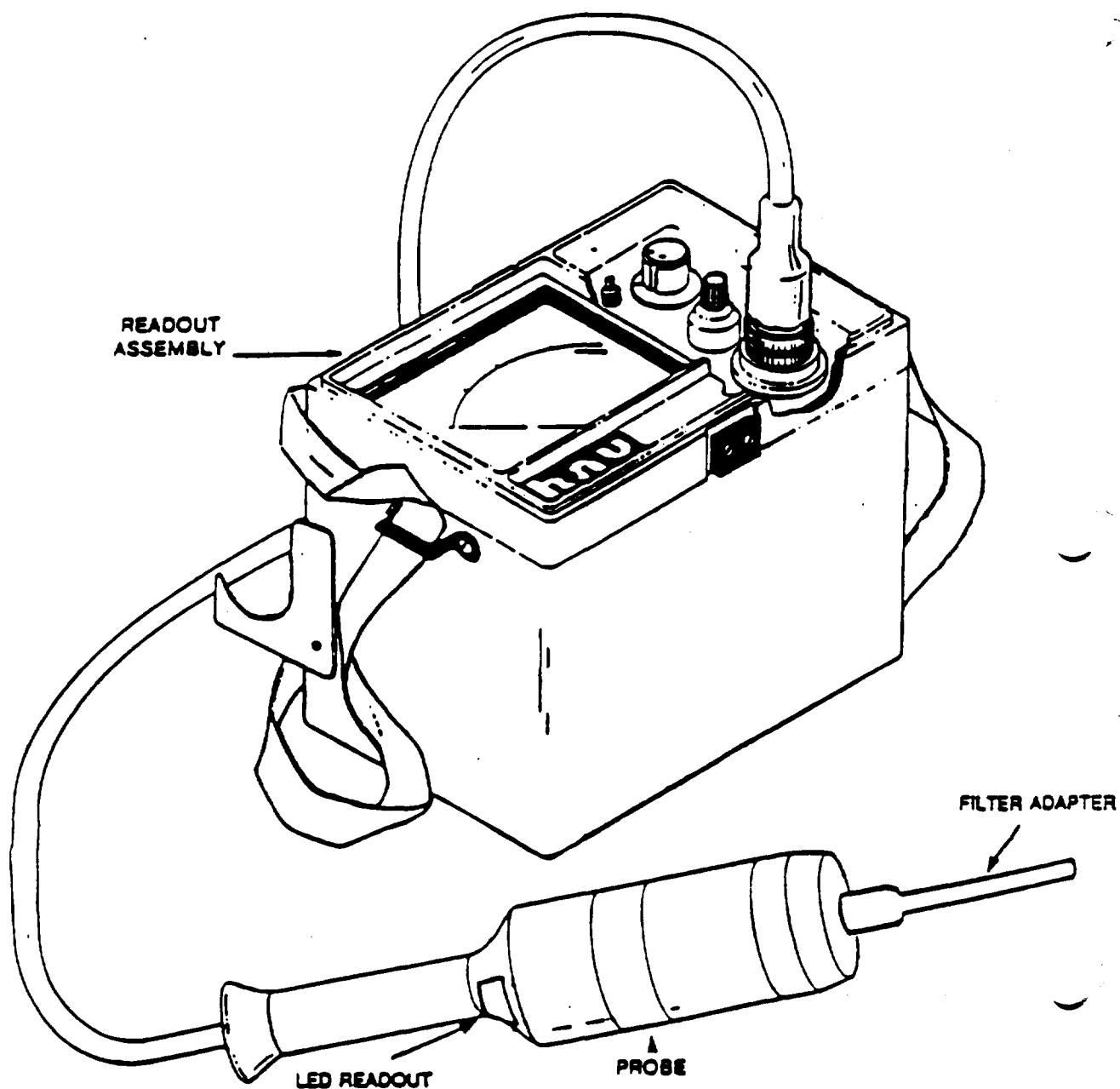
This manual describes the operation, maintenance and parts list for the Photoionization Analyzer, Model HW 101, HNU Systems Inc., 160 Charlamont St., Newton, MA 02161, tel: 617-964-6690.

#### 1-3 EQUIPMENT DESCRIPTION

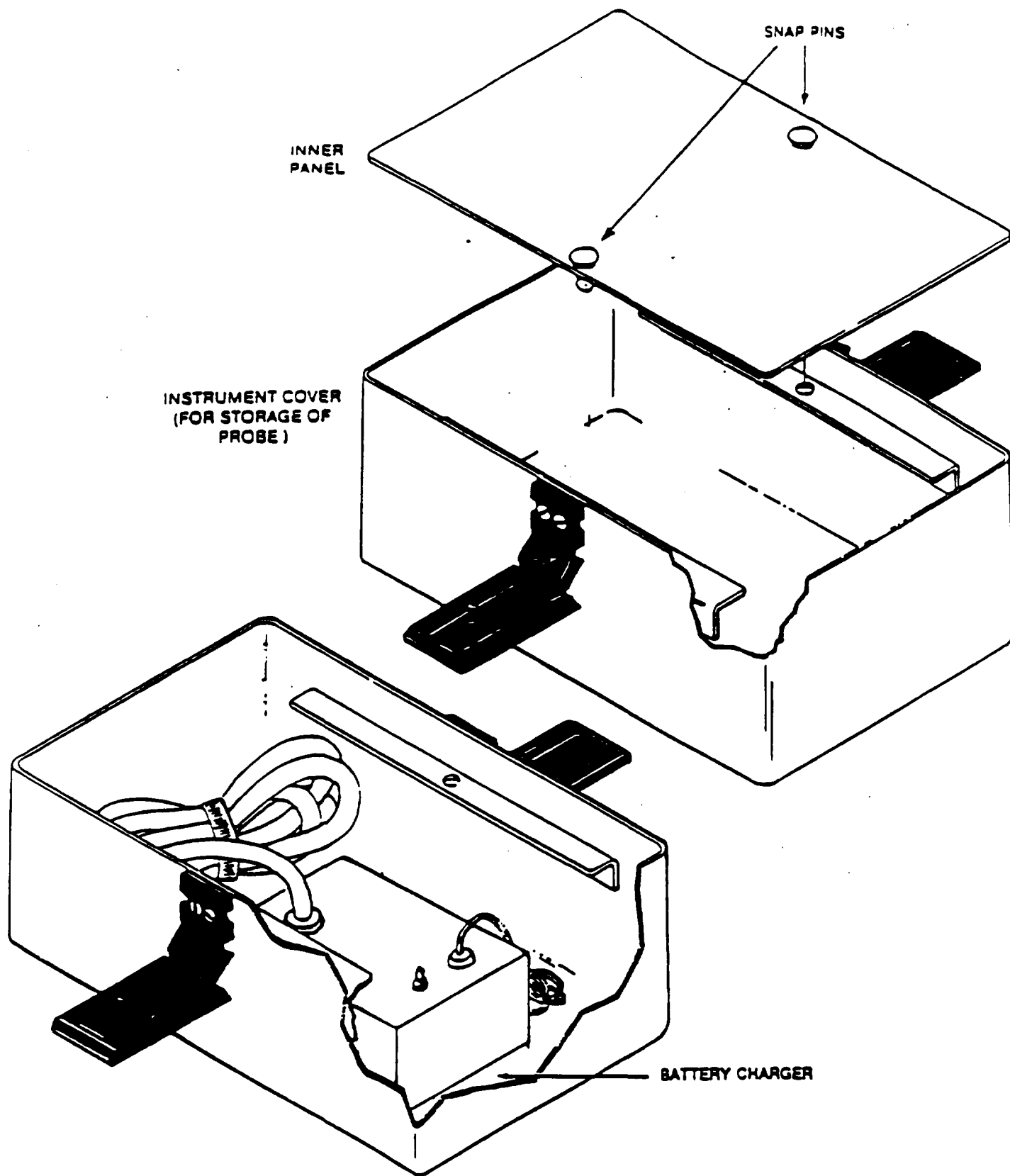
The Photoionization Analyzer is a portable instrument used to detect and measure the concentration of a variety of hydrocarbon gases in various atmospheres. The analyzer consists of a probe and a readout assembly (see Figure 1-1). The probe contains the sensing and amplifying circuitry; the readout assembly contains the meter indicator, controls, and power supply.

Reference data on the analyzer is given in Table 1-1. Physical characteristics of the equipment are given in Table 1-2.

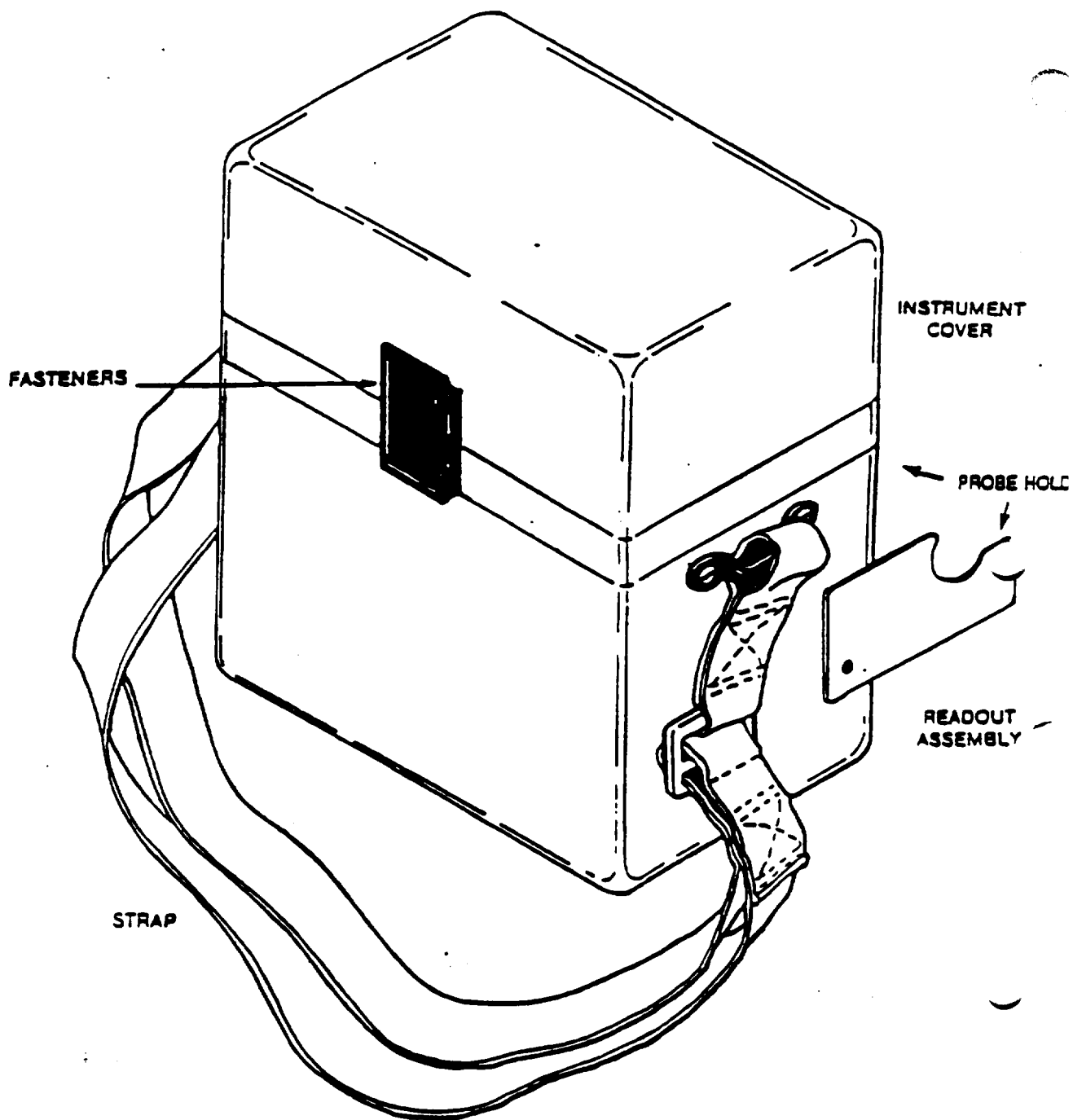
Characteristics of equipment required for maintenance and calibration are given in Table 1-3.



**FIGURE 1-1  
PHOTOIONIZATION ANALYZER  
OPERATING CONDITION**



**FIGURE 1-2**  
**BATTERY CHARGER**  
**STORAGE**



**FIGURE 1-3**  
**PHOTOIONIZATION ANALYZER**  
**STORED CONDITION**

## CHAPTER 5

### TROUBLESHOOTING

#### 5.1 INTRODUCTION

The initial step of any troubleshooting is a thorough visual inspection to look for possible loose or open connections, shorts, dust or other obvious conditions.

Detailed troubleshooting for fault location and correction is accomplished in steps outlined in the following.

Fault Logic Diagram	Figure 5-1
Test Points, Power Supply PCB	Figure 5-2
Troubleshooting Data	Table 5-1
Troubleshooting Index	Table 5-2
Fuse Index	Table 5-3
Indicator Lamp Index	Table 5-4
Relay Index	Table 5-5
Pad Data, Power Supply PCB	Table 5-6
Pin Data, Amplifier PCB, P2/J2	Table 5-7
Pin Data, Probe Cable, P3/J3	Table 5-8

Disassembly and reassembly as may be required for checking the equipment or changing parts are described in Chapter 6.

#### WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise high voltage of -1200 VDC will be present.

#### WARNING

Do not observe the light source closer than 6 inches. When necessary, observe only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

#### WARNING

When conducting tests on analyzer in open condition, exercise great care due to presence of high voltage.

TABLE 5-1  
TROUBLESHOOTING DATA

Symptom	Probable Cause	Corrective Action
1. Meter indicates low battery	a. Battery charge low	1) Recharge battery, check meter with function switch in BATT position to ensure the charger is operating properly (See Table 2-1)
	b. Battery dead	1) Disconnect battery and check with voltohmmeter. Should read -11 to -15 V DC. Replace if dead. (See Section 6-2.2)
	c. Blown fuse (F1, 2A, Fig. 3-3)	1) Check fuse. If blown, check low battery for evidence of shorts in wiring, then replace fuse.
	d. Bad connections	1) Check wiring connections. Repair poor or bad connections.
	e. Broken meter movement	1) Tip instrument rapidly from side to side. Meter needle should move freely, and return to zero. If faulty, replace with new meter.
2. Low battery	a. Power supply defective.	1) Check power supply voltages (see Figure 5-2 and Table 5-6). If in error replace control assembly.

3. UV Lamp not ON

- |                                                                                                   |                                                                                                                                                                    |
|---------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| a. High Voltage interlock (Microswitch S2) at probe cable connector on readout assy not operating | 1) Check by applying pressure to switch plunger with cable in place. Adjust hex screw on side of cable connector, if required to increase throw of switch plunger. |
| b. High voltage supply out or faulty.                                                             | 1) Check high voltage output on power supply board (pad 22). If voltage not correct (See Table 5-3) replace control assembly.                                      |
| c. Lamp not making proper connection with high voltage                                            | 1) Remove lamp, clean and tighten contacts, re-install lamp.                                                                                                       |
| d. Lamp faulty                                                                                    | 1) Replace lamp.                                                                                                                                                   |
| e. Short in high voltage lines.                                                                   | 1) Check wiring from power supply board to probe cable connector (J3 pin D) to UV lamp contacts (D1). Remove any shorts.                                           |

4. Pump not running

- |                             |                                                                                                                                |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| a. Pump stuck               | 1) Disassemble probe and clean passages with care.                                                                             |
| b. Pump connections faulty  | 1) Check for wiring connections at pump motor and at probe cable connector. Repair as required.                                |
| c. Low or dead battery      | 1) Check battery output (power supply board, pad 8) Recharge or replace battery as required.                                   |
| d. Pump voltage not correct | 1) Check pump voltage (power supply board pads 19 and 21, probe cable pins A and C). If not correct, replace control assembly. |



Symptom	Probable Cause	Corrective Action
		2) If pump voltages correct, replace pump.
5. Meter does not respond.	a. Dirty or open probe connection.	1) Clean and tighten or resolder connections in probe.
	b. Broken meter movement.	1) See 1-e-1 above.
	c. Dirty or open connections to meter	1) Clean and tighten connections at meter.
	d. Low or dead battery	1) See 4-c-1 above.
	e. Blown fuse	1) See 1-a-1 above.
6. Meter does not return to zero in STANDBY	a. Broken meter movement	1) See 1-e-1 above.
	b. Dirty or open connections to meter	1) See 5-c-1 above.
	c. Dirty or open connections in probe.	1) See 5-a-1 above.
	d. Zero adjust faulty	1) Rotate zero adjust pot (see Fig. 2-1) (R50, Fig. 3-4). Check pot output at meter probe connector (J3 pins B and L). If voltage does not vary, replace zero adjust pot.
	e. Amplifier faulty	1) Rotate zero adjust pot. Check amplifier output at power supply PCB (Pad 11), amplifier board connector (P2/J2 pin E), or probe connector (P3/J3 pin E), or observe meter. If voltage level on meter does not respond, replace amplifier board.

<u>Symptom</u>	<u>Probable Cause</u>	<u>Corrective Action</u>
	f. Ion chamber shorted	1) Clean ion chamber. (See para. 4-3) Recheck analyzer operation in returning to zero at STANDBY.  2) Replace ion chamber.
Meter readings high or low.	a. Incorrect calibration	1) Recalibrate (see para 4-4).
	b. Lamp dirty.	1) Clean lamp (see para 4-3).
	c. Contamination in ion chamber.	1) Clean ion chamber (see para. 4-3).
	d. O ring leaking or missing	1) Check O rings and adjacent surfaces (see para. 6-2.1).
	e. Power supply board faulty.	1) Check power supply board outputs. (pads 17, 20, and 22 Table 5-3). If voltages not correct, replace control assembly.
	f. Dirty or loose connections.	1) Clean or tighten connections at amplifier board, probe cable, and meter.
	g. Probe may be leaking	1) Place finger over filter nozzle inlet and check flow at the exhaust. There should be no flow.  2) Remove filter nozzle and place finger over inlet and recheck flow at exhaust. There should be no flow.  3) If still leaking, remove end cap and ion chamber and block inlet to pump at small "O" ring on retainer. There should be no flow. If still leaking at this point, call HNU Service Department.

Symptom	Probable Cause	Corrective Action
8. Meter erratic, unstable or non-repeatable	a. Loose cable connection	1) Check cable connection at control panel. Observe meter. Tighten cable as required.
	b. Dirty or loose meter connections	1) Check meter connections. Clean and tighten as required.
	c. Contamination in ion chamber.	1) Clean ion chamber. (see para. 4-3).
	d. Power supply board	1) See 7-0-1 above.
	e. Unstable or noisy	1) Observe lamp (Important: see Warning, Section 1. If operation noisy, replace lamp.)
	f. Function switch in high gain, most sensitive position (i.e., 0-20ppm)	1) Unstable meter operation is common with function switch in most sensitive position. Turn switch to less sensitive position desirable.
	g. Pump not operating properly.	1) See 7G
	h. Gas flow slow or	1) See 4-a-1 above.
	i. Meter contacts dirty or loose.	1) Clean and tighten contacts
	j. Electromagnetic interference	1) See 2-4.2
9. Drifting meter readings	h. Hi Voltage Interblock	1) See 3-A-1
	a. Ion Chamber contaminated.	1) Clean ion chamber. (See para. 4-3)
10. LED Readout on probe	a. Out completely Meter OK	
	b. Some segments out	

TABLE 5-2  
TROUBLESHOOTING INDEX

al	Troubleshooting alignment / adjustment (Table 5-2 Para.)	Diagram (Fig. No.)	Functional Description (Para.)
<hr/>			
	1, 4, 5	3-4	3-2
'Circuitry	5, 6, 7, 8, 9	3-4	3-2
	1, 5, 6, 7, 8	3-4	3-2
ply	2, 3, 4, 7, 8	3-4	3-2
	4, 8	3-4	3-2
	3, 7, 8	3-4	3-2
er	6, 7, 8	3-4	3-1, 3-2

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TABLE 5-3

## PAD DATA, POWER SUPPLY PCB

Pad No.	Signal Name	Voltage (Vdc)
1	Battery Positive(+)	0
2	Ground	0
3	Battery Charger (+)	0
4	Low Battery Indicator	
5	Low Battery Indicator	
6	Hi-Volt Relay Disconnect -Pump Ground	-12(See Note)
7	Battery Charger (-)	-11 to -15
8	Battery negative (-)	-11 to -15
9	Battery negative (-)	-11 to -15
10	Hi-Volt relay disconnect	0 or -12
11	Amplifier Signal	0 to -5
12	Signal divider for span control	0 to -5
13	" " " " "	"
14	" " " " "	"
15	" " " " "	"
16	" " " " "	"
17	Ion chamber accelerating voltage	+180
18	Zero adjust voltage power	+18 to +21
19	Not Used	
20	Amplifier Power	-9.5 tol(
21	Pump Power	-10.nominal (see NOTE)
22	UV Lamp	up to -1200 (see para32)
23	Output Signal to Meter	0 to -5
24	Battery Check Voltage	-11 to -15
25	Not Used	
26	Signal Feedback	0 to -5
27	Ground	0
28	Ground	0
29	Not Used	
30	Ground	0
31	Ground	0

NOTE: Differential voltage for pump between pads 21(+) and 6(-) will be between 9.0 and 11.0 volts DC.

TABLE 5-4  
PIN DATA, AMPLIFIER PCB, P2/J2

PIN #	Signal Name	Voltage (V DC)
-		
A	Ground	0
B	Span Control Setting	varying
C	Zero Adjust	varying
D	Amplifier Power	-9.5 to -10.5
E	Amplifier Signal	0 to -15.0
F	Zero Adjust Voltage	+18 to +21
3	Zero Adjust	varying

TABLE S-5

## PIN DATA, PROBE CABLE. P3/J3

Pin #	Signal Name	Voltage (V DC)
A	Pump Ground	-12 nominal
B	Zero Adjust	varying
C	Pump Power	-1.0 nominal
D	UV Lamp	up to -1200 (see para. 3-2)
E	Amplifier Signal	0 to -5.0
F	Ground	0
H	Span Control Setting	varying
J	Ground	0
K	Zero adjust Voltage	+18 to +21
L	Zero Adjust	varying
M	Ion Chamber accelerating voltage	+180
N	Amplifier Power	-9.5 to -10.5

NOTE: Differential potential for pump between pins C(+) and A(-) will be between 9.0 and 11.0 Volts DC.

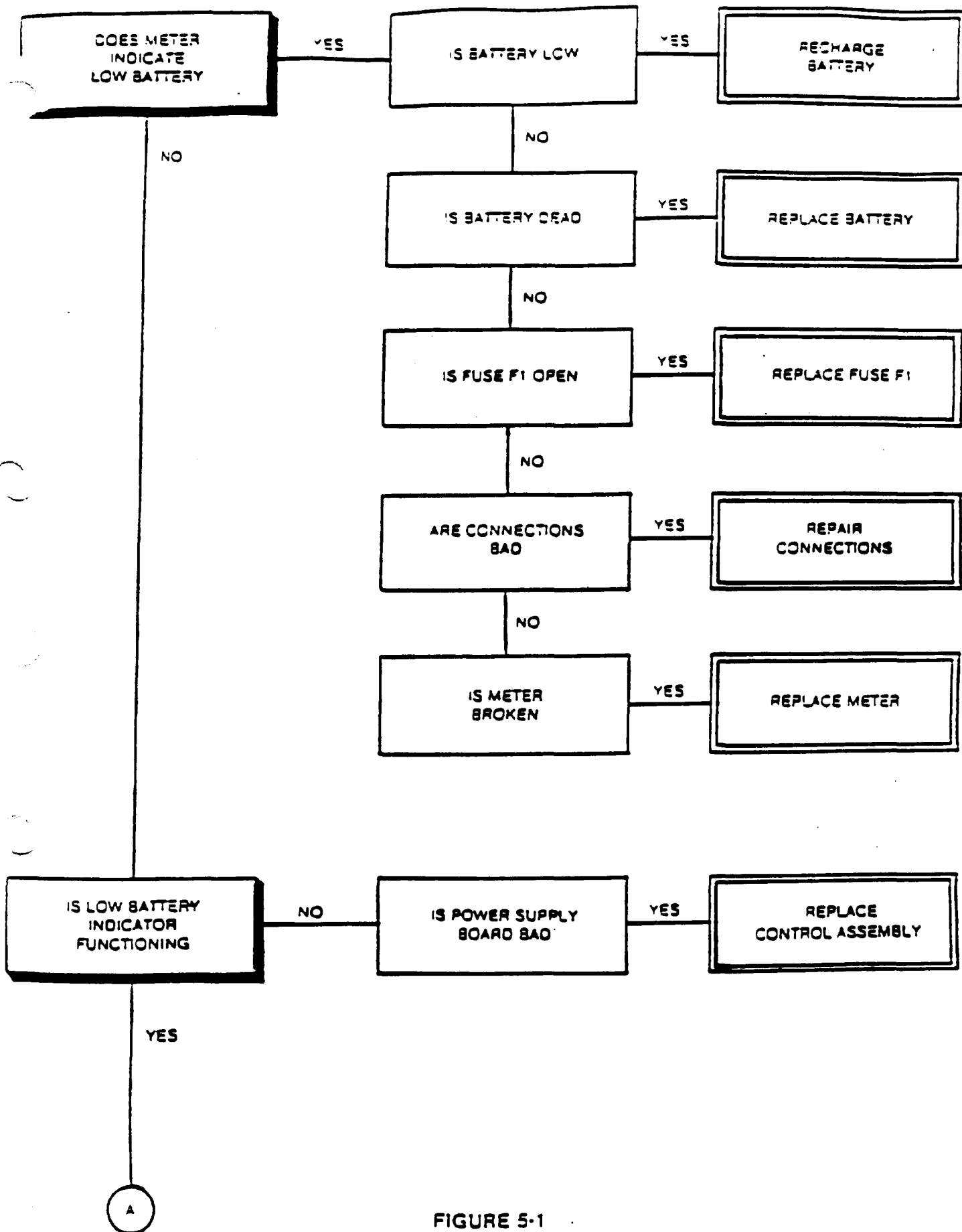
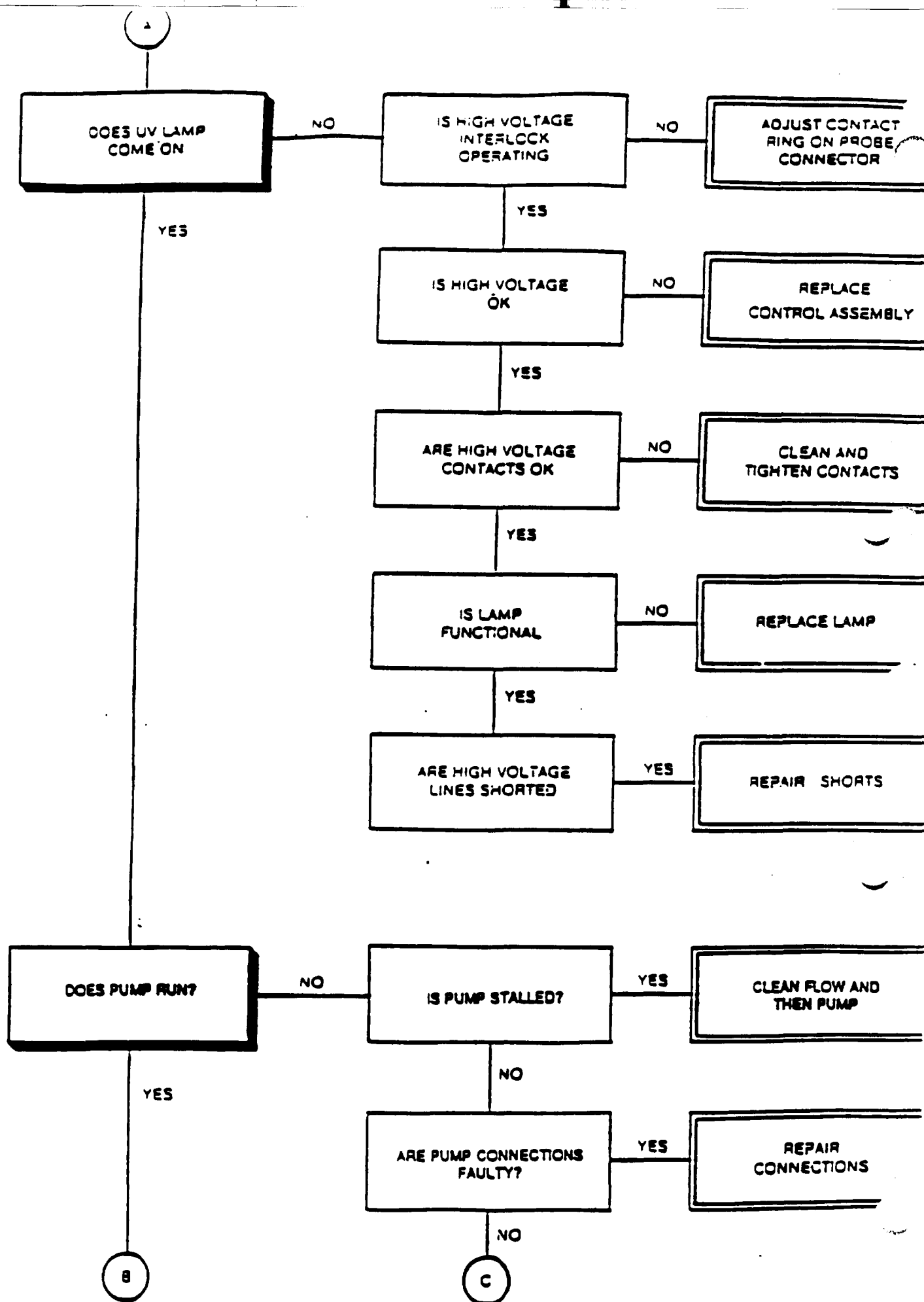
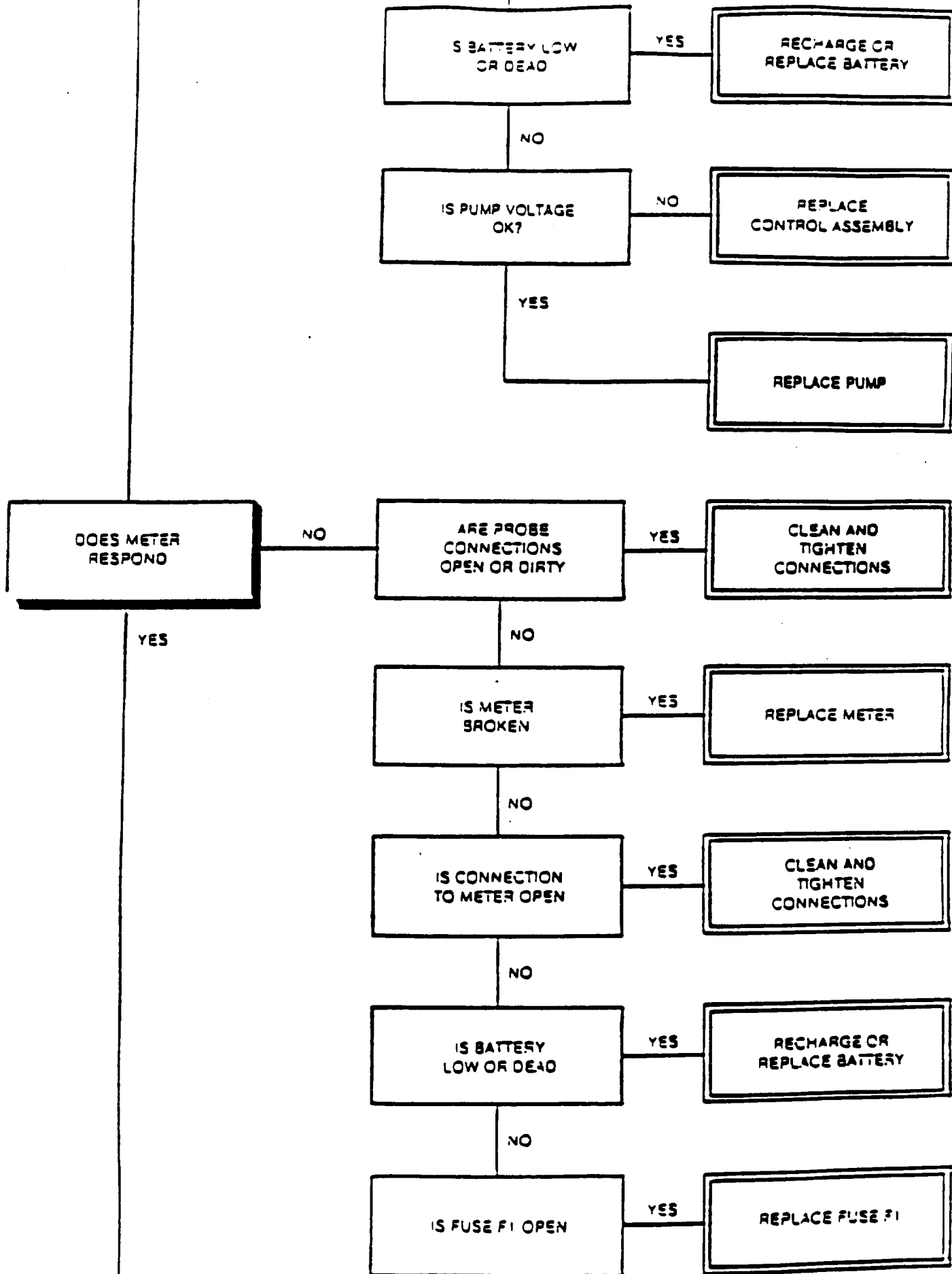
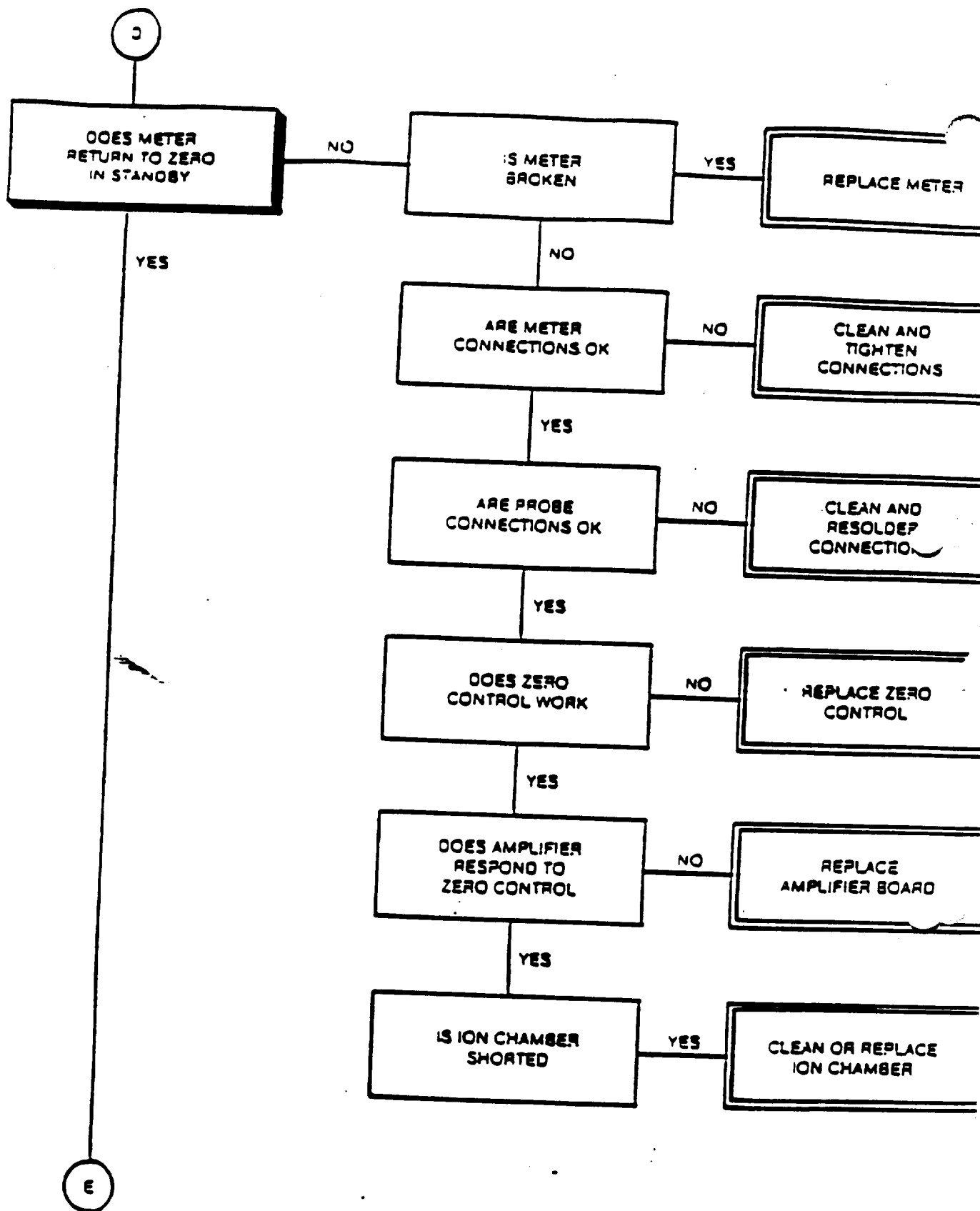


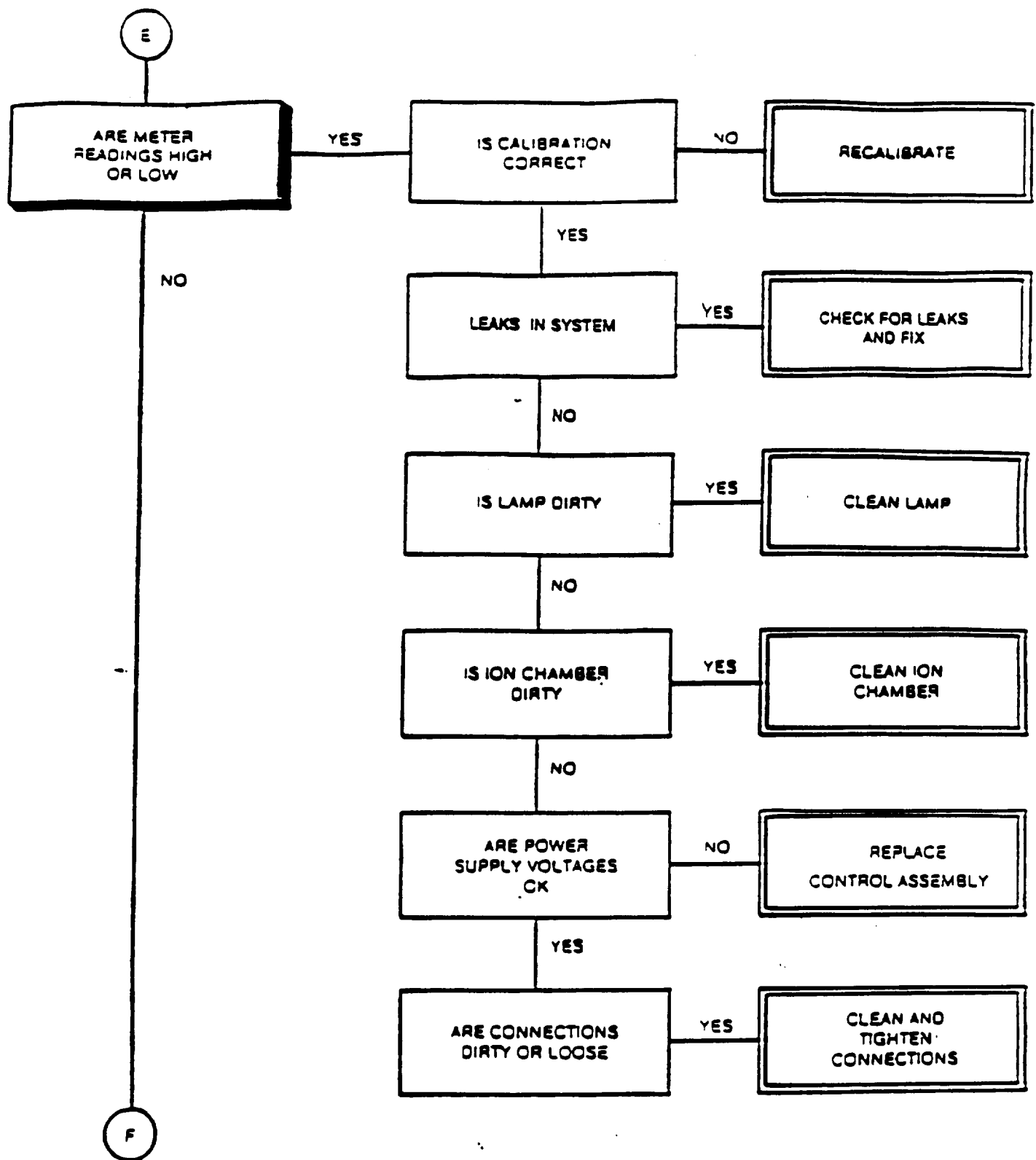
FIGURE 5-1  
FAULT LOGIC DIAGRAM

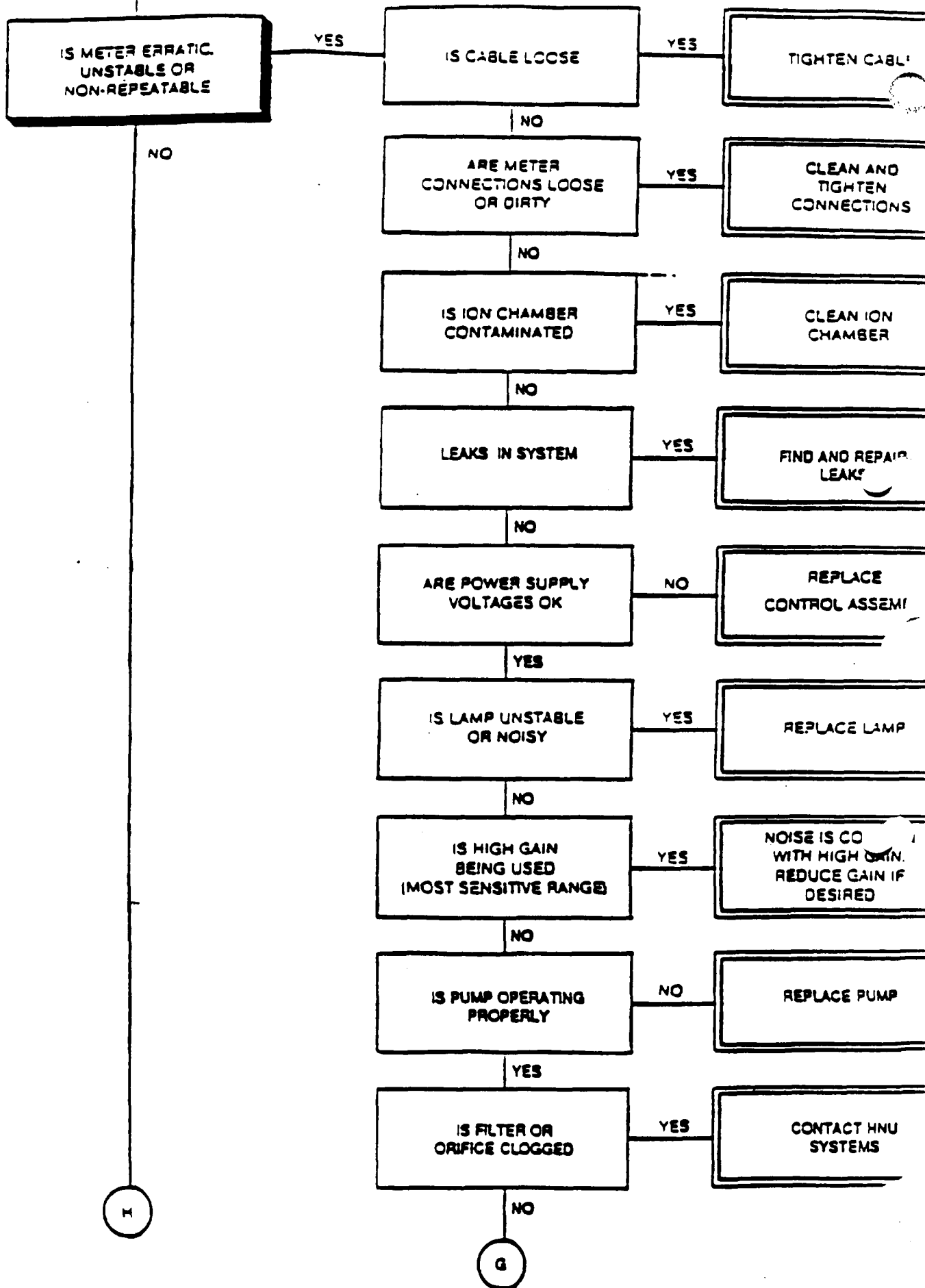


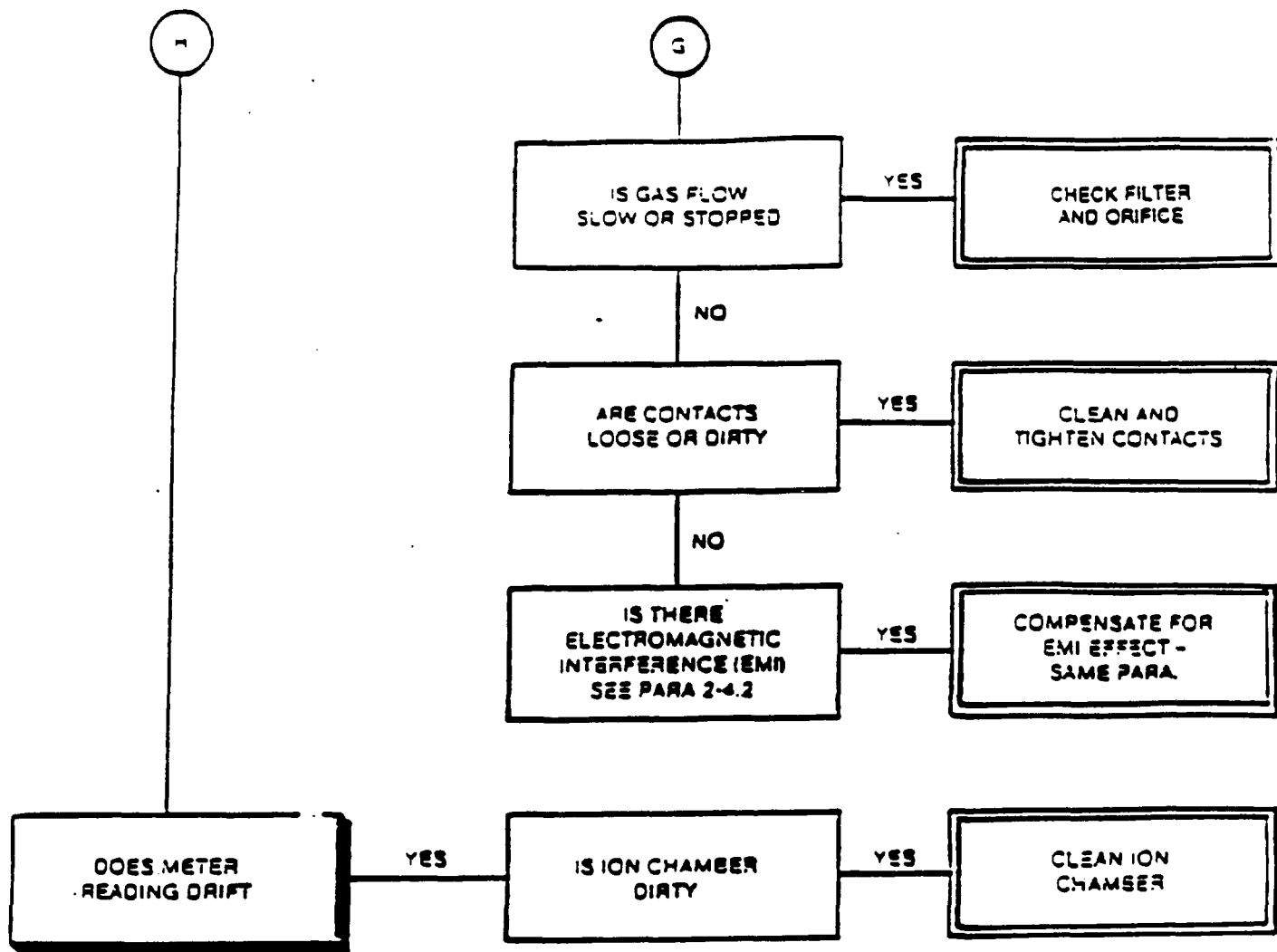




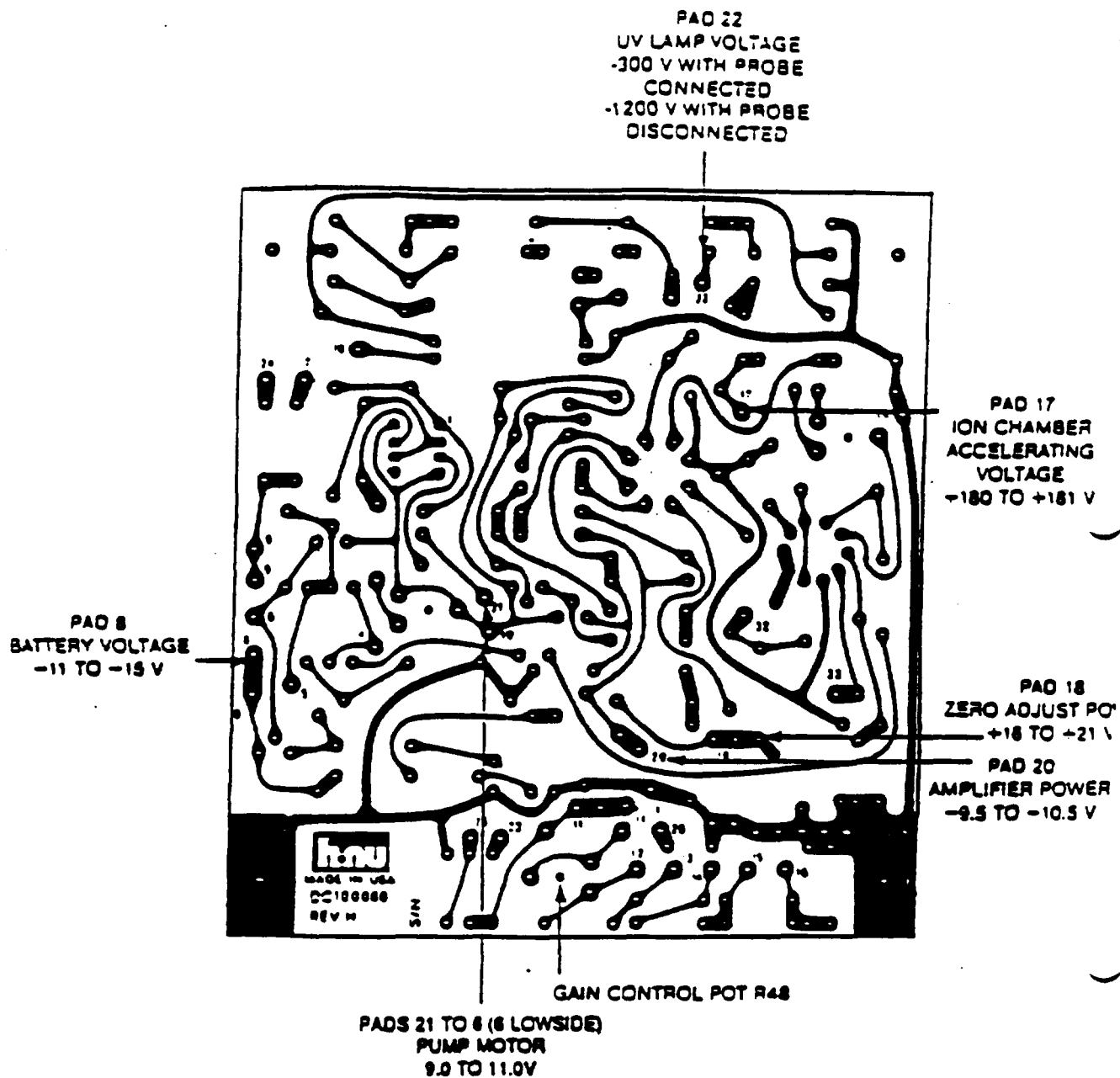








Note: For further details, see Table 5-1.



**FIGURE 5-2  
TEST POINTS  
POWER SUPPLY PCB**

## CHAPTER 6

### CORRECTIVE MAINTENANCE

#### 6-1 INTRODUCTION

The scope and function of corrective maintenance of the analyzer consists of the disassembly, replacement of component parts and subassemblies and the reassembly... All adjustments and calibrations are described in chapters 2 through 5.

#### 6-2 EQUIPMENT DISASSEMBLY/REASSEMBLY

Disassembly and reassembly of the analyzer for maintenance and part replacement can be accomplished as follows.

##### 6-2.1 PROBE ASSEMBLY

###### WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise high voltage of -1200 VDC, will be present.

Disconnect the probe cable connector at the readout assembly.

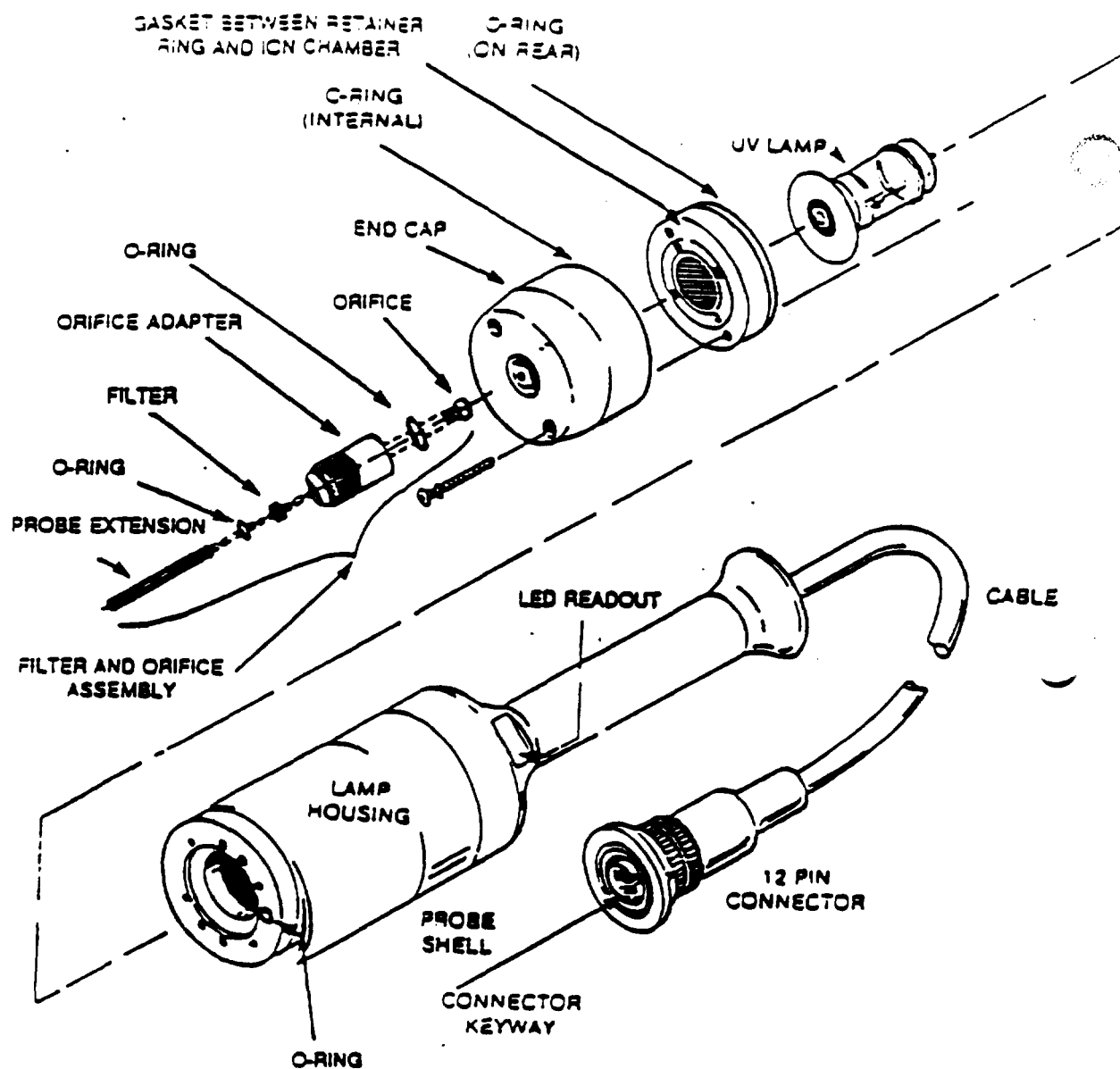
Hold the lamp housing with the black end cap upright. Loosen the screws on the top of the end cap, separate the end cap and ion chamber from the lamp and lamp housing.

###### CAUTION

Care must be taken so that the ion chamber does not fall out of the end cap or the light source does not fall out of the lamp housing.

Be sure to retain all "O" rings and gaskets to ensure leak tight reassembly.





**FIGURE 6-1  
PROBE ASSEMBLY**

Turn the end cap over in the hand. Tap lightly on the top. The ion chamber should fall out of the end cap.

Place one hand over the top of the lamp housing and tilt slightly. The lamp will slide out of the housing.

Clean or replace the lamp as required (see Section 4-3 for lamp cleaning).

Remove any dust or particles that may be deposited in the sample passages by gently blowing, or by lightly brushing with a camels hair brush. Extreme care is required to prevent damage to the pump.

Inspect the surfaces adjacent to the O-rings for evidence of leakage. Replace any O-rings where such evidence appears. A special tool is required to remove the lamp housing from the probe. Contact HNU Systems.

The amplifier board can be removed from the lamp source housing subassembly, (see Fig. 6-2) by unsnapping the coaxial connector, J1, and then removing the retaining screw. The amplifier board will then slide out of the housing assembly.

Reassemble the probe by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the lamp housing, making sure that the contacts are properly aligned, and "O" rings are seated correctly. The ion chamber fits only one way.

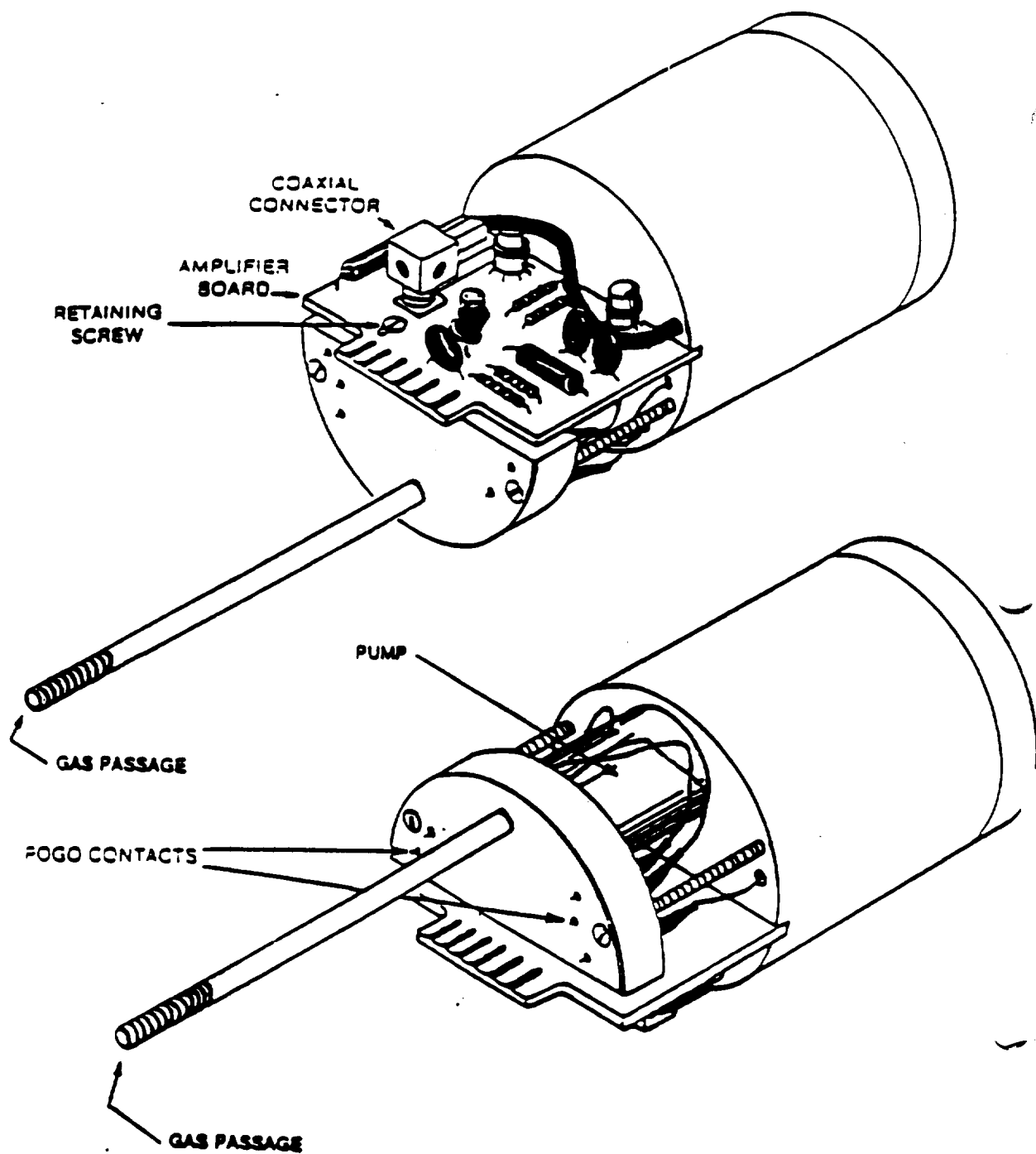
Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws enough to seal the O-ring. Check to be sure the assembly is leak tight by blocking the sample inlet and checking for no-flow at the exhaust.

#### CAUTION

Check ion chamber alignment. It only fits one way.

Align the 12 pin probe connector to the readout assembly and reconnect with a twisting motion until a click occurs. Check to ensure the high voltage microswitch is properly depressed.

Perform zero adjustment (Section 2-3, steps f thru h) and calibrate (Section 4-4) after probe repair, lamp replacement, or probe replacement.



**FIGURE 6-2**  
**LIGHT SOURCE**  
**SUBASSEMBLY**

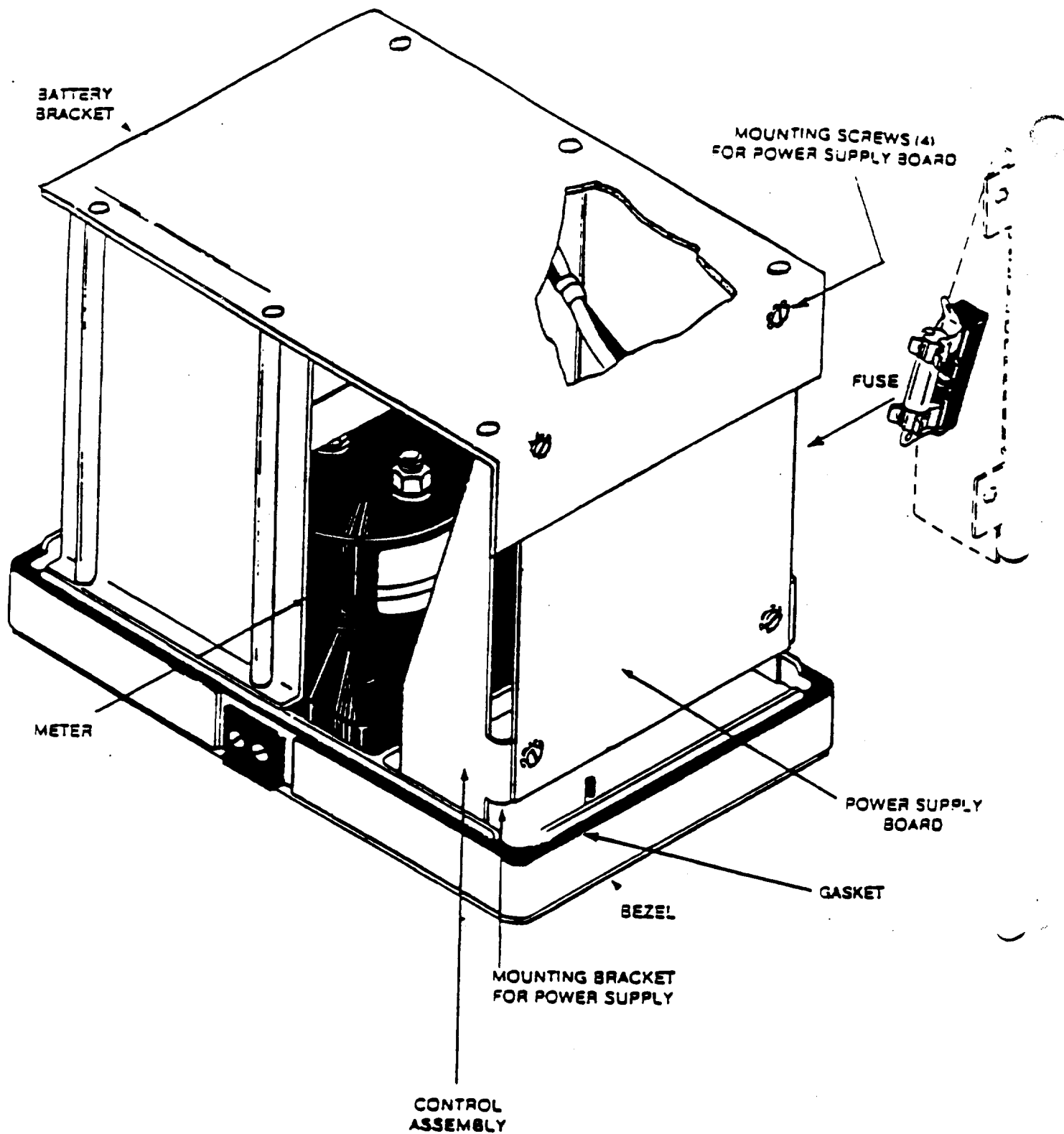
## 6-2.2 READOUT ASSEMBLY

### WARNING

-----  
Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of - 1200 VDC will be present.

Disconnect the probe cable connection. Loosen the screw on the bottom of the case and, holding the instrument by the bezel, remove the case. (See Fig. 6-3). Remove and replace the subassemblies as follows:

- a. Control assembly - The control assembly is bonded to the bezel and is not removable.
- b. Meter - The meter may be removed and replaced by the following steps. (Maintain sealing gasket in original location)
  - 1) Disconnect the leads from the meter.
  - 2) Remove 2 screws from clamps holding meter in place.
  - 3) Loosen 2 nuts on clamps.
  - 4) Move clamps inward to clear opening.
  - 5) Move bezel with meter forward out of assembly.
  - 6) Transfer the clamps to the new meter.
  - 7) Reverse steps 1) thru 6) to install new meter.



**FIGURE 6-3  
READOUT ASSEMBLY**

c. Battery - The battery may be removed and replaced by the following steps:

- 1) Disconnect the molex connector to the battery.
- 2) Remove 4 screws on battery bracket holding battery in place.
- 3) Remove battery from the bracket on the end away from the control assembly.
- 4) Install new battery by reversing steps 1) thru 3) above.
- 5) On the power supply board, turn R53 (see Figure 5-2) a 20 turn 10k potentiometer, fully counter clockwise.
- 6) Charge the battery until fully charged (approx. 2 hrs).
- 7) Operate the analyzer on one of the three ppm range settings for 4 1/2 hours.
- 8) Adjust R53 (see Figure 5-2) in a clockwise direction until the low battery LED indicator just comes on.
- 9) Recharge the battery. The analyzer will now operate for 10 hours before the low battery indicator comes on.

*—*

Figure & Index No.	Part Number	Description 1 2 3 4 5 6 7	Units per Assy
1	AC103981	Probe assembly: provides gas detection	1
2	AD103960	Shell and cable assy: consists of shell, base, handle, knob cable and connector	1
3	DA100049-1	Exhaust screw	1
4	AC103980	Lamp Housing: provides housing p ifie PCB light source (lamp)	1
6	AB100008-A1	Pump Assy	1
7	AB102256-A1	Amplifier PCB	1
8	AD103983	Ion chamber assy	1
9	DB100053-1	End cap	1
10		Screw: end cap assy, 6-32 x 1 1/4 pin head, with internal tooth standard washer #6, both stainless steel	2
11	DB104124	Probe extension: 8" length	1
12	568-020	O-Ring: Ion chamber seal, 1" O.D., 70 Duro ARP, (90512)	1
13	568-012	O-Ring: Extension seal, 7/16" ID 70 Duro ARP, (90512)	1
14	568-005	O-Ring: seal, 7/32" OD, 70 Duro, ARP, (90512)	1
15	568-002	O-Ring: seal, 13/16" OD, 70 Duro, ARP, (90512)	1

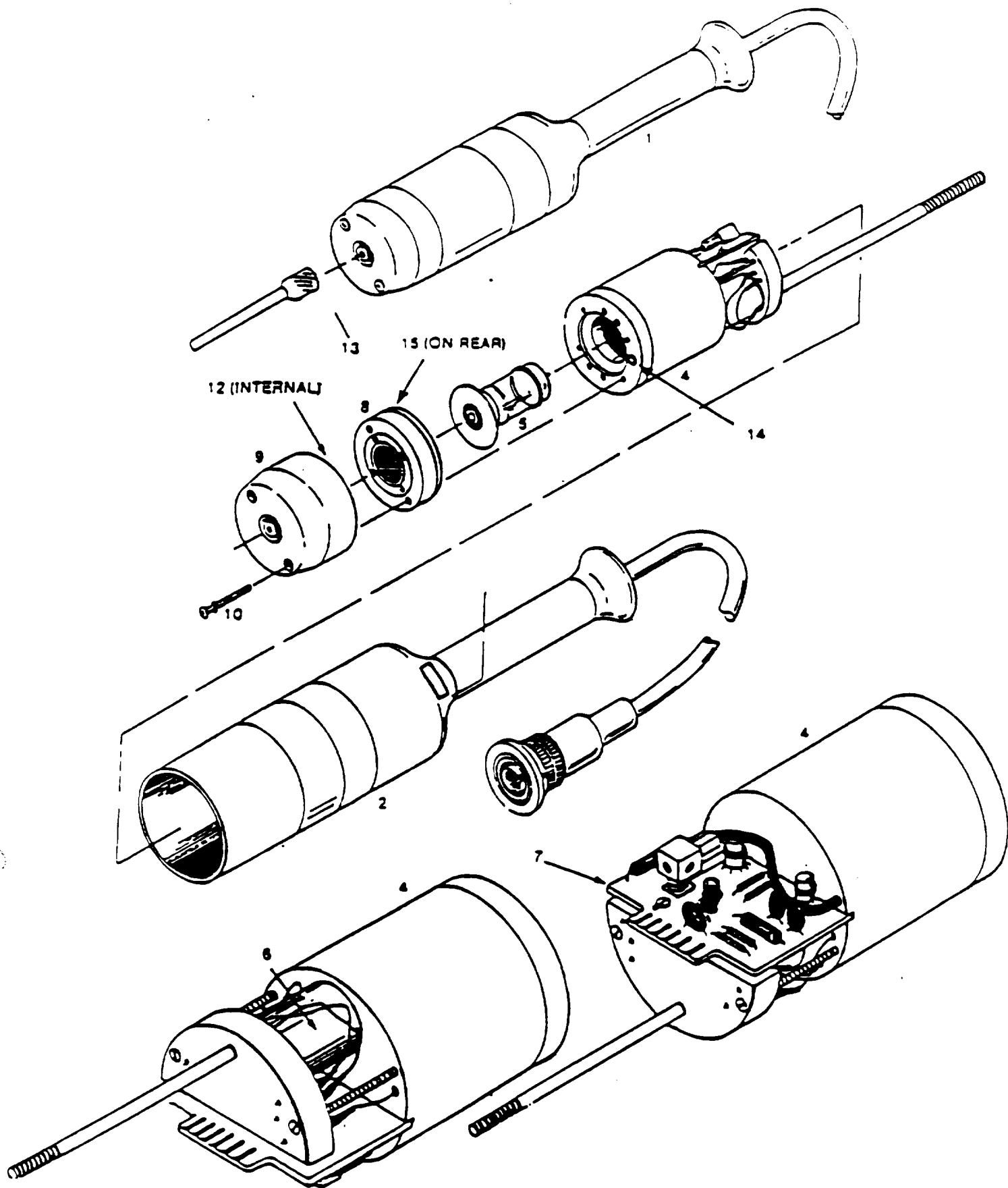
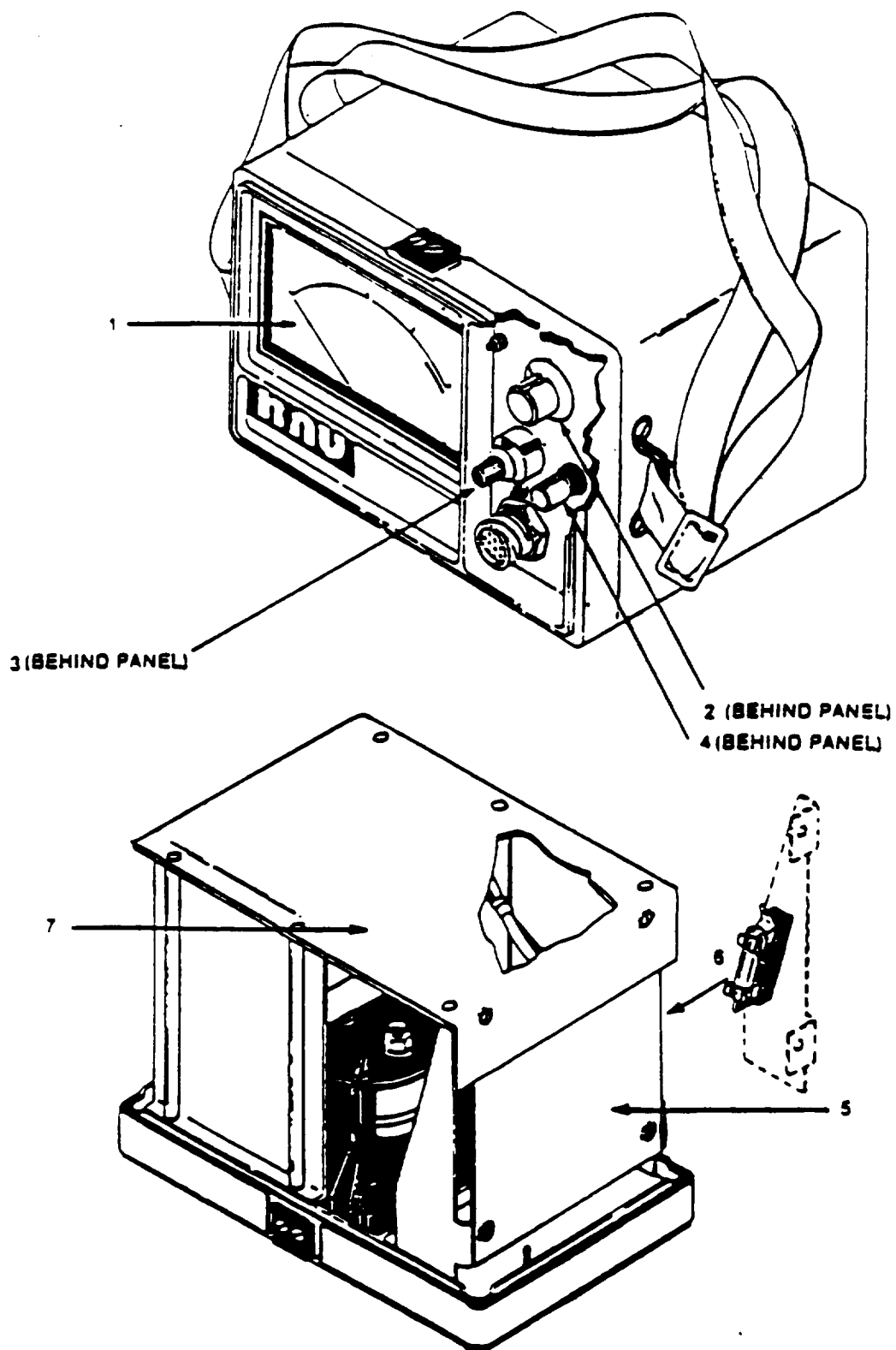


FIGURE 7-1  
PARTS LOCATION, PROBE

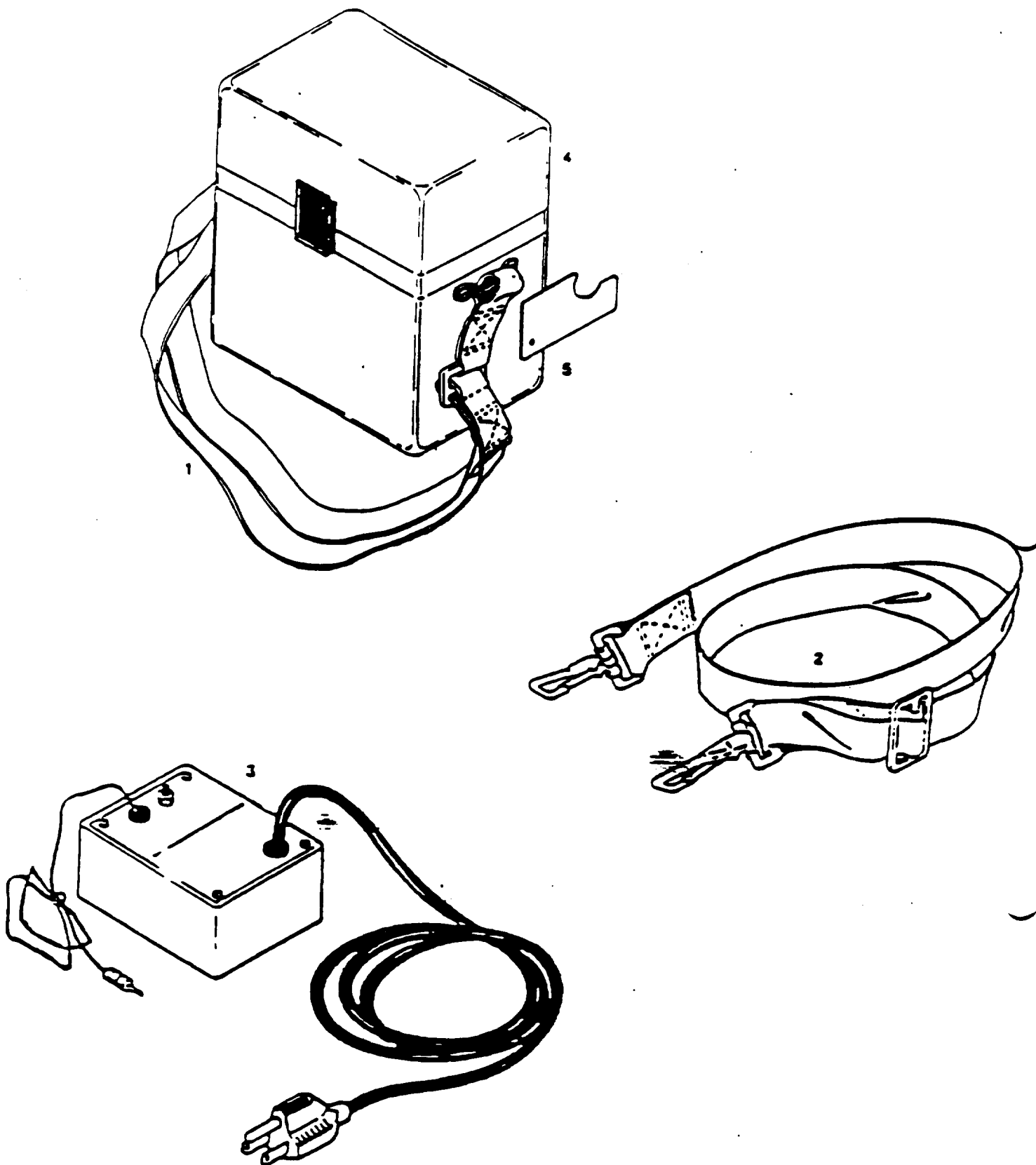


# GROUP ASSEMBLY PARTS LIST

Figure & Index	Part Number	Description 1 2 3 4 5 6 7	Units Per Assy
7-2	AC103959	Readout assy: provides control and indications	
	AC103961	Meter & Bezel Assy	
1	DC#00012-1	Meter: 4 1/2" (11.3 cm.), Taut band movement, graduated 0-5-10-15-20 division	
2	AB100086-A1	Switch: Function switch, rotary 6 position, (Ref Des: S1)	
3	DA101816-1	Potentiometer: span control, 10 turn 100K, Spectrol #534 (02111) (Ref Des: R51)	
4	DA100029-1	Potentiometer: zero adjust turn, 10K, CTS #VA45R103A (23223) (Ref Des: R50)	
5	AC103963	Control assy: consists of bracket power supply PCB, cable fuse and power jack	
6		Fuse: 2A, Bussman #AGC-2 (71400) or Fusetron #MDL-2 (07689) (Ref Des: F1)	
7	AA100011-A1	Battery: 12 V dc, 2.5 ampere-hours (Ref Des B1)	
7-3	1 DB100017-1	Strap, neck: supports readout assy from neck of operator when in use	
	2 DB100018-1	Strap, waist: secures readout assy to waist of operator when in use	
	3 AC102269-A1	Charger, battery: 15.0 V dc, 120 Vac, 1ph input,	
	4 DD102240	Case, cover	
	5 DB100050-1	Case, readout assy	
	AC103953	Display Driver Board Assy	
	AB103965	Low Bat Board Assy	



**FIGURE 7-2**  
**PARTS LOCATION, READOUT ASSEMBLY**



**FIGURE 7-3**  
**PARTS LOCATION, OUTER ASSEMBLY**

# NUMERICAL INDEX

Part Number	Figure and Index Number	Source	Codes	
			Maintenance	Recoverability
AD102242	1-1	PD	3L	L
AA100011-A1	7-2-7	PA	3L	L
AA100111-A1	7-1-11	PA	3Z	Z
AB100008-A1	7-1-6			
AB100086-A1	7-2-2			
AB102256-A1	7-1-7	PA	3L	L
AC100004-A1	7-1-2	PA	3G	G
AC100107-A1	7-1-4	PA	3Z	Z
AC102257-A1	7-1-1	PA	3L	L
AC102260-A1	7-2-5	PA	3L	L
AC102269-A1	7-3-3	PA	3Z	Z
AGC-2	7-2-6	PA	3Z	Z
OA100029-1	7-2-4			
DA100049-1	7-1-3	PA	3Z	Z
DA101816-1	7-2-3			
DB100017-1	7-3-1			
DB100018-1	7-3-2			
DB100050-1	7-3-5			
DB100053-1	7-1-9	PA	3Z	Z
DB100012-1	7-2-1	PA	3Z	Z
OD102240	7-3-4	PA	3Z	Z
MDL-2 or AGC-2	7-2-7	PA	3Z	Z
PA100009-A1	7-1-5	PA	3Z	Z
PA100010-A1	7-1-12 thru 7-1-15			
VA45R103A	7-2-4			
534	7-2-3			
568-025	7-1-15	PA	3Z	Z
568-005	7-1-14	PA	3Z	Z
568-012	7-1-13	PA	3Z	Z
568-020	7-1-12	PA	3Z	Z
AC100005-A1	7-1-8	PA	3L	L
DC102573	4-3-1	PA	3Z	Z
DC102579	4-3-2	PA	3Z	Z

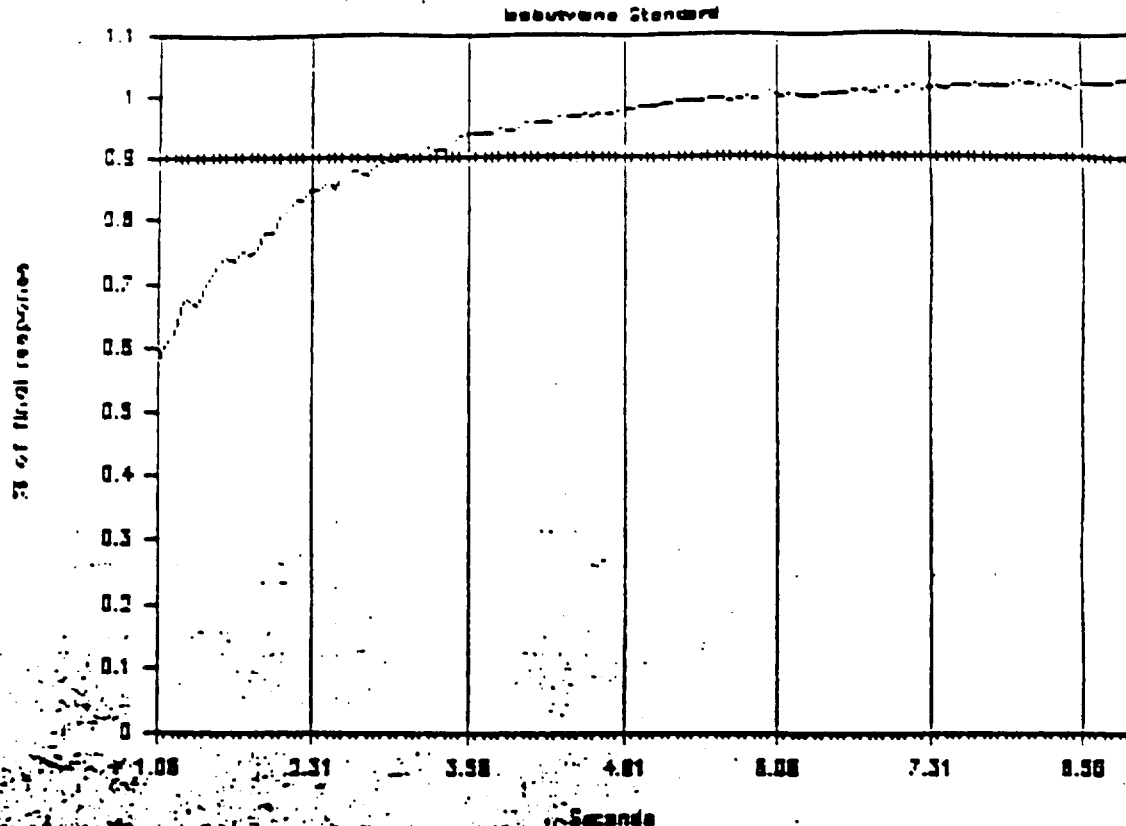
# REFERENCE DESIGNATION INDEX

Reference Designation	Part Number
B1	AA100011-A1
F1	AGC-2 or MDL-2
R50	DA100029-1, VA45R103A
R51	DA101816-1, 534
S1	AB100086-A1

AVAILABLE SPARE PARTS KITS

PA100010-A1	O-Ring Kit: Contains two each of 568-020, 568-012, 568-005 and 568-002
PA-102743-A1	Five Piece Spare Parts Kit: Contains one each of PA100009-A1 UV light source, AA100011-A1 Battery, AB102256-A1 Amplifier PCB, AC102260-A1 Control Assembly and PA100010-A1 O-Ring Kit.
PA-102744-A1	Three Piece Spare Parts Kit: Contains one each of PA100009-A1 UC light source, AA100011-A1 Battery and PA100010-A1 O-Ring Kit.

# Response Time for S/N: 970139



## \*\*\*\*\* TECHNICAL SPECIFICATIONS REPORT \*\*\*\*\*

### HW-101 TEST RESULTS

S/N: 970139

LAMP VOLTAGE	-409.23 VOLTS	LAMP TYPE:	10.2ev
BIAS VOLTAGE	178.81 VOLTS	LAMP S/N:	R866
PUMP VOLTAGE 1	-1.82 VOLTS	PUMP S/N:	5427A
PUMP VOLTAGE 2	-10.94 VOLTS	POWER SUPPLY S/N:	1353
PUMP VOLTAGE	9.12 VOLTS	CHARGER S/N:	8863
BATTERY CHARGER	-14.97 VOLTS	AMP BOARD S/N:	8183
RECORDER OUTPUT	-1.27 VOLTS	BATTERY S/N:	970139
POT	-0.88 VOLTS	POT VALUE	2208.36 OHMS
BATTERY	-12.69 VOLTS	GAIN RESISTOR:	5.6meg OHMS
+20 VOLTS	19.28 VOLTS		
-10 VOLTS	-9.97 VOLTS	TEST DATE	05/08/89
MILLIBAR READING: 255-MBAR		TEST TIME	10:44:10
RESPONSE TIME	3.00 seconds		
ISOBUTYLENE	51 ppm	DATE OF QC INSPECTION:	_____
FLOW RATE cc/min	179.05	DATE TO STOCK:	_____
		DATE SHIPPED:	5-10-89

**APPENDIX B**  
**INSTRUCTION MANUAL**  
**FOR THE FOXBORO® ORGANIC VAPOR ANALYZER**  
**FLAME IONIZATION DETECTOR**

**(20 Pages)**



# Instruction

MI  
611-132  
November 1990

## OVA 128 CENTURY™ ORGANIC VAPOR ANALYZER

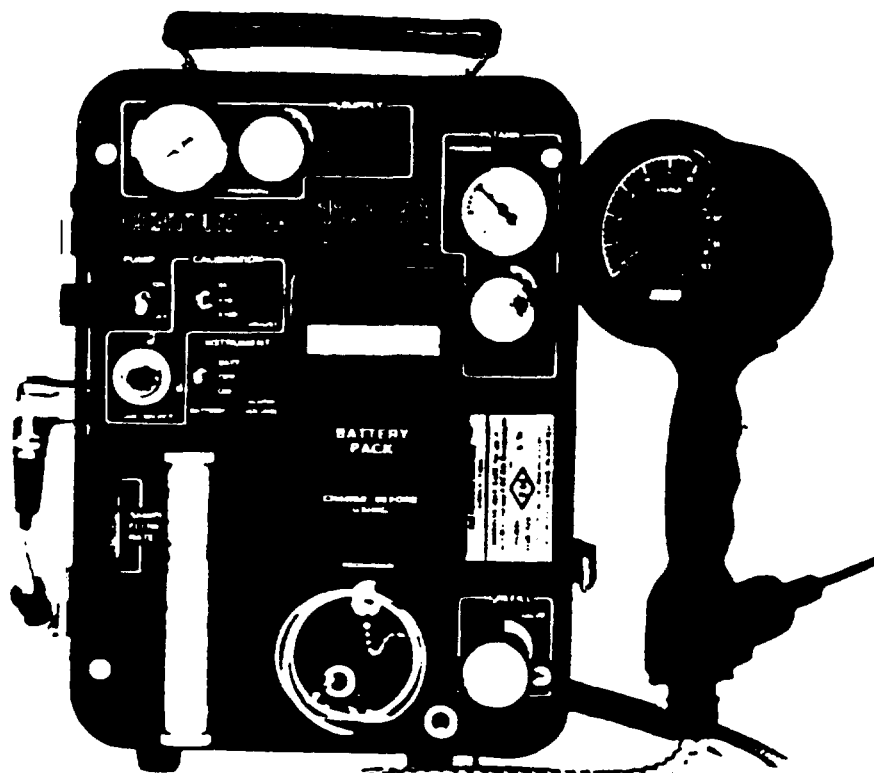


Figure 1.  
Portable Organic Vapor Analyzer

### NOTE:

*New Telephone  
and Fax Numbers*

Tel. (508) 378-5400  
FAX (508) 378-5505

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## INTRODUCTION

The OVA 128 CENTURY Organic Vapor Analyzer (OVA 128) is manufactured in two configurations. These are:

- Basic Flame Ionization Detector for monitoring total hydrocarbons
- Gas Chromatograph (GC) supplied with two columns

A battery charger can be ordered for either 120 V ac, 60 Hz or for 220 V ac, 50 Hz. Electrical Certifications are:

- FM certified for use in Class I, Groups A, B, C, and D, Division 1 hazardous locations.
- BASEEFA certified intrinsically safe. Ex 1b, for IIC, Zone 1, Temperature Class T4. BASEEFA No. 76002/B Std. SFA 3007.

Accessories for the OVA 128 are:

- Strip Chart Recorder - either FM or BASEEFA certified.
- Activated Charcoal Filter Adapter - used for zeroing the analyzer in a contaminated environment and to differentiate the methane and ethane portions from the total hydrocarbon reading. Also used with desiccant as a moisture trap.
- Sample Diluter Kit for 10:1, 25:1, or 50:1 sample dilution.
- Septum Adapter for direct on-line syringe injection with the GC.
- Portable Isothermal Pack (PIP) for temperature control of GC columns.

The OVA 128 is a sensitive instrument designed to measure trace quantities of organic vapors in air. It is essentially a flame ionization detector such as utilized in laboratory gas chromatographs and has similar analytical capabilities. The flame ionization detector is an almost universal detector for organic compounds with the sensitivity to measure in the parts per million range (V/V) in the presence of atmospheric moisture, nitrogen oxides, carbon monoxide, and carbon dioxide.

The instrument has broad application since it has a chemically resistant air sampling system and can be readily calibrated to measure almost all organic vapors. It has a single linear scale readout from 0 ppm to 10 ppm with a X1, X10, and X100 range switch. This range expansion feature provides accurate readings across a wide concentration range with either 10, 100, or 1000 ppm full scale deflection. Designed for use as a portable survey instrument, it can also be readily adapted to fixed remote monitoring or mobile installations. It is ideal for the determination of many organic air pollutants, for monitoring the air in potentially contaminated areas, for soil gas analysis, and for sample screening.

The OVA 128 is certified by Factory Mutual (FM) for use in Class I, Groups A, B, C, and D, Division 1 hazardous locations. Similar foreign certifications have been obtained, including BASEEFA. This requirement is especially significant in industries where volatile flammable products are manufactured or used, and for hazardous waste monitoring where unknown and possible explosive atmospheres exist, or for vapor analysis in enclosed environments. Such instruments must be incapable, under normal or abnormal conditions, of causing ignition of hazardous mixtures in the air. In order to maintain the certified safety, it is important that the precautions outlined in this manual be practiced and that no modifications be made to these instruments.

It is highly recommended that the entire manual be read before operating the instrument. It is essential that all portions relating to safety of operation and maintenance be thoroughly understood.

## Reference Documents

MI 611-101	OVA 128 Operation of Tri-Column GC Option
MI 611-105	Operation of Portable Isothermal Pack
MI 611-137	OVA 88, 108, 128 Analyzer General Replacement of Meter in Battery Charger
MI 611-144	OVA 88, 108, 128 Analyzer General Replacement Kit to Rebuild High and Low Pressure Regulators
MI 611-170	Operation of Diluter Kit
MI 611-171	OVA 128 Operation of Calibration Kit
PL 611-132	OVA 128 Parts List
620030	- OVA Sample Loop Installation

## GENERAL DESCRIPTION

The OVA 128 Analyzer is designed to detect and measure hazardous organic vapors and gases. It has broad application since it has a chemically resistant sampling system and can be calibrated to almost all organic vapors. It can provide accurate indication of gas concentration in one of three ranges: 0 to 10 ppm; 0 to 100 ppm; or 0 to 1000 ppm. While designed as a lightweight portable instrument, it can be permanently installed to monitor a fixed point.

The instrument utilizes the principle of hydrogen flame ionization for detection and measurement of organic vapors. The instrument measures organic vapor concentration by producing a response to an unknown sample, which can be related to a gas of known composition to which the instrument has previously been calibrated. During normal survey mode operation, a continuous sample is drawn into the probe and transmitted to detector chamber by an internal pump.

The sample stream is metered and passed through particle filters before reaching the detector chamber. Inside the detector chamber, the sample is exposed to a hydrogen flame which ionizes the organic vapors. When most organic vapors burn, they leave positively charged carbon-containing ions. An electric field drives the ions to a collecting electrode. As the positive ions are collected, a current corresponding to the collection rate is generated. This current is measured with a linear preamplifier which has an output signal proportional to the ionization current.

A signal conditioning amplifier is used to amplify the signal from the preamp and to condition it for subsequent meter or external recorder display. The display is an integral part of the Readout Assembly and has a 270° scaled deflection.

In general, the hydrogen flame ionization detector is more sensitive for hydrocarbons than any other class of organic compounds. The response of the OVA varies from compound to compound, but gives repeatable results with all types of hydrocarbons: i.e., saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes and alkynes), and aromatic hydrocarbons.

Typical response to various hydrocarbons, relative to methane is as follows (see Note below):

Compound	Relative Response (percent)	
Methane	100	(reference)
Hexane	75	
Propane	70	
N-butane	63	
N-pentane	65	
Ethylene	85	
Acetylene	225	
Benzene	150	
Toluene	110	
Ethane	80	

— at TWA

#### NOTE

Each OVA detector will have slightly different responses for organic vapors relative to methane. Users should determine responses for their individual instrument(s). The typical response of various compounds relative to methane is as follows:

#### KETONES:

Acetone	60
Methyl Ethyl Ketone	80
Methyl Isobutyl Ketone	100

#### ALCOHOL

Methyl Alcohol	12
Ethyl Alcohol	25
Isopropyl Alcohol	65

#### HALOGEN COMPOUNDS

Carbon tetrachloride	10
Chloroform	65
Trichloroethylene	70
Vinyl chloride	35

Compounds containing oxygen, such as alcohols, ethers, aldehydes, carboxylic acid, and esters give a lower response than that observed for hydrocarbons. This is particularly noticeable with compounds having a high ratio of oxygen to carbon such as the lower members of each series which have one, two or three carbons. With compounds containing higher numbers of carbons, the effect is diminished to such an extent that the response is similar to that of the corresponding hydrocarbons.

Nitrogen-containing compounds (i.e., amines, amides, and nitriles) respond in a manner similar to that observed for oxygenated materials. Halogenated compounds also show a lower relative response as compared with hydrocarbons. Materials containing no hydrogen, such as carbon tetrachloride, give the lowest response; the presence of hydrogen in the compounds results in higher relative responses. Thus,  $\text{CHCl}_3$  gives a much higher response than does  $\text{CCl}_4$ . As in the other cases, when the carbon to halogen ratio is 5:1 or greater, the response will be similar to that observed for simple hydrocarbons.

The OVA has negligible response to carbon monoxide and carbon dioxide which, due to their structure, do not produce appreciable ions in the detector flame. Thus, other organic materials may be analyzed in the presence of  $\text{CO}$  and  $\text{CO}_2$ .

## Applications

1. Measurement of most toxic organic vapors present in industry for compliance with Occupational Safety and Health Administration (OSHA) requirements.
2. Evaluation and monitoring applications in the air pollution field.
3. Source identification and measurement for fugitive emissions (leaks) as defined by EPA.
4. Forensic science applications.
5. Controlling and monitoring atmospheres in manufacturing and packaging operations.
6. Leak detection related to volatile fuel handling equipment and underground storage tanks.
7. Monitoring the background level of organic vapors at hazardous waste sites.
8. Quality control procedures geared to leak checking, pressurized system checks, combustion efficiency checks, etc.
9. SARA Title III compliance.
10. Soil gas monitoring.

## Major Features

The basic instrument consists of two major assemblies, the Readout Assembly and the Sidepack Assembly. The recorder is optional on all models, but is normally used with all instruments which incorporate the GC Option. The output meter and alarm level adjustments are incorporated in the Readout Assembly.

The Sidepack Assembly contains the remaining operating controls and indicators, electronic circuitry, detector chamber, hydrogen fuel supply, and electrical power supply.

Other major features are: linear scale readout, approximately two second response time and portable operating time of eight hours for fuel supply and battery pack. A battery test feature allows charge condition to be read on the meter. Hydrogen flame-out is signified by an audible alarm plus a visual indication on the meter. The instrument contains a frequency modulated detection alarm which can be set by the operator to sound at a desired concentration level. The frequency of the detection alarm varies as a function of detected level, giving an audible indication of organic vapor concentration.

An earphone is provided to allow the operator to hear the alarm in noisy areas or to avoid disturbing other workers.

During use, the Sidepack Assembly can be carried by the operator on either the left or right side, or as a back pack. The Readout

Assembly can be detached from the Sidepack Assembly and disassembled for transport and storage.

## Standard Accessories (See Figure 3)

A variety of sampling probes can be used. In addition, small diameter tubing can be used for remote sampling, or electrically insulated flexible extensions can be used for places that are difficult to reach.

## Telescoping Wand

Wand length can be increased or decreased over a 22- to 30-inch range to suit the individual user. A knurled locking nut is used to lock wand at desired length. The wand is attached to Readout Assembly. When appropriate, the wand is replaced with a Close Area Sampler, which is supplied as a standard accessory.

## Sampling Accessories

Part Number	Description
510125-1	Close area sampler - Connects directly to the readout assembly.
CR009LX	Telescoping wand - Adjustable length - accommodates the tubular sampler (wand) listed below.
510126-1	Tubular sampler - Used with the telescoping wand.

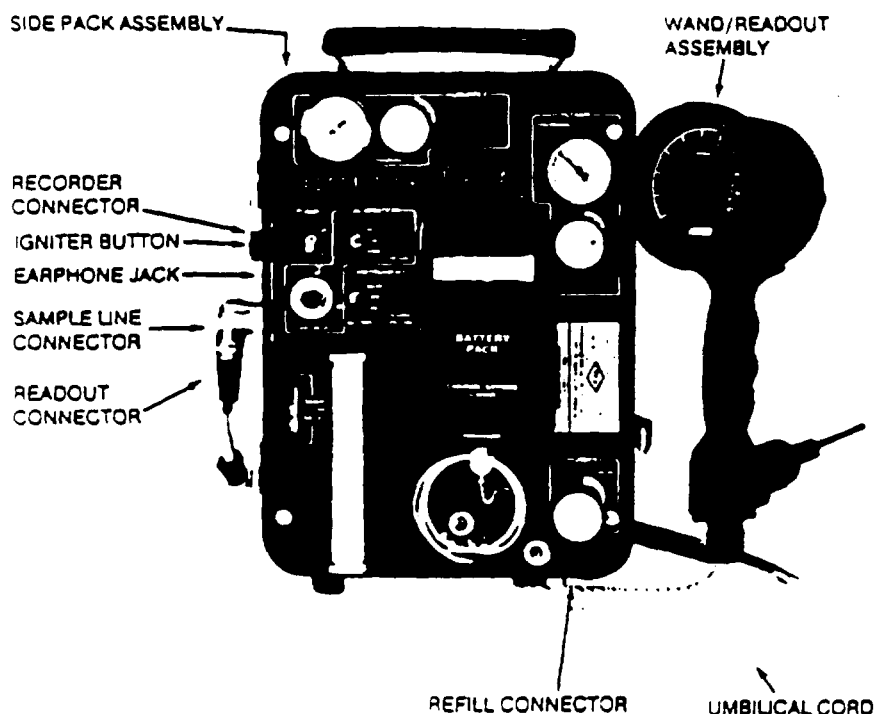


Figure 2. Portable Organic Vapor Analyzer Model OVA 128

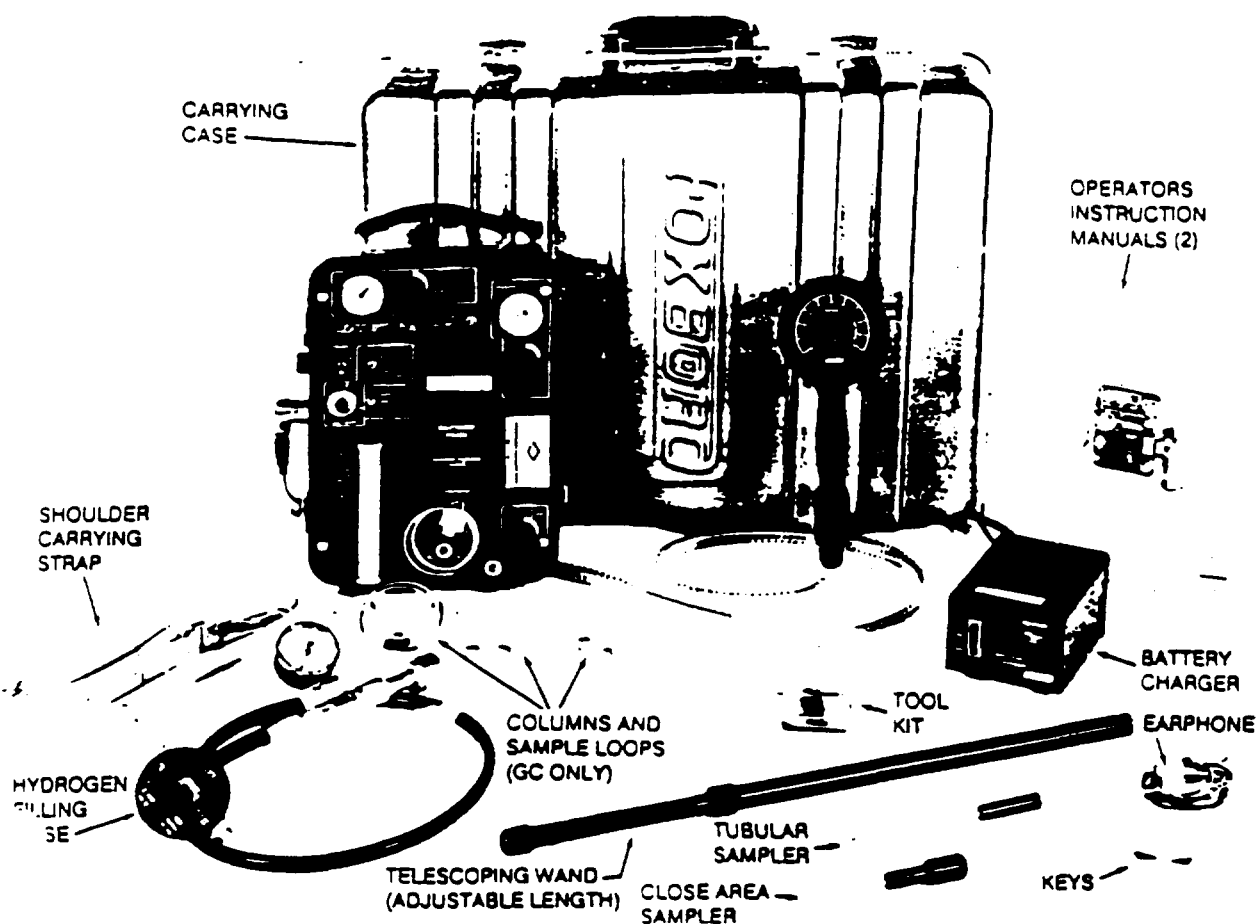


Figure 3. OVA 128 Analyzer Components (Gas Chromatograph Model Shown)

## Particulate Filters

The primary filter of porous stainless steel is located behind the sample inlet connector (see Sidepack Assembly drawing). In addition, a replaceable porous stainless steel filter is installed in the "close area" sampler.

## Carrying Case

An instrument carrying case is provided to transport, ship, and store the disassembled Readout Assembly, the Sidepack Assembly, and standard equipment, as well as an optional recorder.

## Standard Specifications

### Standard Accessories (see Figure 3):

1. Instrument carrying/storage case
2. Hydrogen fuel filling hose assembly
3. Battery charger
4. Earphone
5. Various sampling fixtures
6. Maintenance tool kit
7. Operators manual (2 each)
8. Padded leather carrying straps
9. Keys (2)

**Readout:** 0 to 10, 0 to 100, 0 to 1000 ppm (linear)

**Sample Flow Rate:** Approximately 1 L/m at 20°C, 760 mm, using close area sampler

**Response Time:** Approximately 2 seconds for 90% of final reading.

**Primary Electrical Power:** 12-volt (nominal) battery pack.

**Fuel Supply:** Approximately 75 mL volume tank of pure hydrogen, maximum pressure 2400 psig, fillable in case.

**Hydrogen Flow Rate:** Factory set 10.5 ±0.5 mL/min (standard models); 12.0 ±0.5 mL/min (GC option).

**Portable Operating Time:** Maximum 8 hours with battery fully charged, hydrogen pressure at 1800 psig.

**Physical Dimensions:** 229 mm x 305 mm x 127 mm (9 in x 12 in x 5 in) Sidepack only.

**Weight:** 5.5 kg (12 lb), includes Sidepack and hand-held Readout Assembly.

**Detection Alarm:** Audible alarm plus meter indication. User preset to desired level.

**Flame-Out Alarm:** Audible alarm plus meter indication (needle drops off scale in negative direction).

**Battery Test:** Battery charge condition indicated on readout meter.

Filters: In-line sintered metal filters will remove particles larger than 10 microns.  
Operating Temperature Range: 10 to 40°C (50 to 104°F)  
Minimum Ambient Temperature: 15°C (59°F) for Flame Ignition (coldstart).  
Relative Humidity: 5% to 95%. Effect on accuracy:  $\pm 20\%$  of individual full scale  
Electrical Output: 0 to 5 volts  
Minimum Detectable Limit (Methane - Survey Mode): 0.2 ppm  
Accuracy: Based on the use of a calibration gas for each range (see table below):

CALIBRATION TEMP. °C	OPERATING TEMP. °C	ACCURACY IN % OF INDIVIDUAL FULL SCALE		
		X1	X10	X100
20 to 25	20 to 25	$\pm 20$	$\pm 10$	$\pm 10$
20 to 25	10 to 40	$\pm 20$	$\pm 20$	$\pm 20$

## OPERATING PROCEDURES

### Controls and Indicators

#### Sidepack Assembly

1. INSTR/BATT TEST SWITCH - Three-position toggle switch controls all instrument electrical power except the pump and alarm power. It also permits display of the battery charge condition on the readout meter.

#### NOTE

Toggle Switch - switch handle must be pulled to change position. This prevents accidental movement.

2. PUMP (ON/OFF) SWITCH - Toggle switch controls power to the internal pump and audio alarms.

#### NOTE

Toggle Switch - switch handle must be pulled to change position. This prevents accidental movement.

3. IGNITER BUTTON - Momentary push button connects power to the igniter coil in the detector chamber and simultaneously disconnects power to pump.
4. CALIBRATE SWITCH (range selector) - Selects the desired range: X1 (0 to 10 ppm); X10 (0 to 100 ppm); X100 (0 to 1000 ppm).
5. CALIBRATE ADJUST (zero) KNOB - Potentiometer used to "zero" the instrument.

6. GAS SELECT KNOB (span control) - Ten-turn dial readout potentiometer sets the gain of the instrument (commonly referred to as span control). Turning the dial clockwise decreases the resistance and amplifies the readout.

7. ELECTRICAL OUTPUT CONNECTOR - Five-pin connector used to connect the instrument to an external recording device with the following pin connections:

Pin E, +12 V dc  
Pin H, Ground  
Pin B, Signal 0 to 5 V dc

8. CHARGER CONNECTOR - Locking BNC connector used to connect the battery pack to the battery charger.
9. HYDROGEN TANK VALVE - Valve used to supply or close off the fuel supply from the hydrogen tank.
10. HYDROGEN TANK PRESSURE INDICATOR - High pressure gauge measures pressure in the hydrogen fuel tank which is an indication of fuel supply.
11. HYDROGEN SUPPLY VALVE - Valve used to supply or close off hydrogen fuel to the detector chamber.
12. HYDROGEN SUPPLY PRESSURE INDICATOR - Low pressure gauge used to monitor hydrogen pressure at the capillary restrictor.
13. SAMPLE FLOW RATE INDICATOR - Indicator to monitor the sample flow rate.
14. REFILL CONNECTION - 1/4-inch fitting to connect the hydrogen refill hose to the instrument.
15. REFILL VALVE - Valve to open one end of the instrument fuel tank for refilling with hydrogen.
16. EARPHONE JACK - Used to connect the earphone; speaker is disabled when earphone is used.
17. VOLUME KNOB - Potentiometer adjusts the volume of the internal speaker and earphone.
18. READOUT AND SAMPLER CONNECTORS - Used to connect the sample line and cable assembly from the Readout to the Sidepack.

#### Readout Assembly

1. METER - Linear scaled 270° meter displays the output signal level in ppm. Also displays battery condition.
2. ALARM LEVEL ADJUST KNOB - Potentiometer (located on the back of the Readout Assembly) is used to set the concentration level at which the audible alarm is actuated.



## Setup Procedure

\*\*\*\*\*  
\* CAUTION \*  
\*\*\*\*\*

1. Connect the Readout Assembly to the Sidepack Assembly by attaching the sample line and electronic jack to the Sidepack.
2. Select the desired sample probe (close area sampler or telescoping wand) and connect it to the readout handle. Before tightening the knurled nut, check that the probe accessory is firmly seated against the flat seals in the readout handle and in the tip of the telescoping wand.
3. Move the Instr/Batt Switch to the test position. The meter needle should move to a point beyond the white line, indicating that the integral battery has more than four hours of operating life before recharging is necessary.

4. Move the Instr/Batt Switch to the "ON" position and allow a 5-minute warm-up.
5. Turn the Pump Switch on.

### NOTE

Toggle Switch - switch handle must be pulled to change position. This prevents accidental movement.

Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.

7. Turn the Volume Knob fully clockwise.
8. Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.
9. Move the Calibrate Switch to X1 and adjust the meter reading to zero using the Calibrate Adjust (zero knob). Move Calibrate Switch to X10 (to protect motor from pegging when ignited).
10. Open the hydrogen Tank Valve three turns and observe the reading on the Hydrogen Tank Pressure Indicator. (Approximately 150 psi of pressure is required for each hour of operation.)
11. Open the Hydrogen Supply Valve three turns and observe the reading on the Hydrogen Supply Pressure Indicator. The reading should be between 10.5 and 12 psi.

### NOTE

With GC instrument, a column must be installed.

After approximately one minute, depress the Igniter Button until the hydrogen flame lights. The meter needle will travel upscale and begin to read "Total Organic Vapors".

Do not depress igniter for more than four seconds. If flame does not ignite, wait one minute and try again. Allow 20 minutes warm up of preamplifier (P/A) while ignited.

13. The instrument is ready for use.

### NOTE

If the ambient background organic vapors are "zeroed out" using the Calibrate Adjust knob, the meter needle may move off-scale in the negative direction when the OVA is moved to a location with lower background. If the OVA is to be used in the 0 to 10 ppm range, it should be "zeroed" in an area with very low background. A charcoal filter adapter (Part Number 510095-1) can be used to generate the clean background sample.

## Operating Procedure - Survey Mode

The following procedure describes operation of the OVA in the "Survey Mode" to detect total organic vapors.

1. Set the CALIBRATE Switch to the desired range. Survey the areas of interest while observing the meter and/or listening for the audible alarm indication. For ease of operation, carry the Sidepack Assembly positioned on the side opposite the hand which holds the Readout Assembly. For broad surveys outdoors, the sampler probe should be positioned several feet above ground level. When making quantitative readings or pinpointing, the sampler probe should be positioned at the point of interest.
2. When organic vapors are detected, the meter needle will move up-scale and the audible alarm will sound when the set point is exceeded. The frequency of the alarm will increase as the detected level increases.

If the flame-out alarm is actuated, check that the pump is running, then press the igniter button. Under normal conditions, flame-out results from sampling a gas mixture that is above the lower explosive level which causes the hydrogen flame to extinguish. If this is the case, reignition is all that is required to resume monitoring. Another possible cause for flame-out is restriction of the sample flow line which would not allow sufficient air into the chamber to support combustion. The normal cause for such restriction is a clogged particle filter.

Note that the chamber exhaust port is on the bottom of the case and blocking this port will cause fluctuations and/or flame-out.

## Shutdown Procedure

The following procedure should be followed for shutdown of the equipment:

1. Close HYDROGEN SUPPLY VALVE.
2. Close HYDROGEN TANK VALVE.
3. Move INSTR Switch to OFF.

### NOTE

Toggle Switch - switch handle must be pulled to change position. This prevents accidental movement.

4. Wait five seconds and move PUMP Switch to OFF. Failure to do so will discharge the battery to a point where it will not retain a full charge. INSTRUMENT IS NOW IN A SHUTDOWN CONFIGURATION.

## H2 Fuel Refilling

### NOTE

Use PREPURIFIED, LABORATORY grade (Ultra High Purity - 99.999), or ZERO grade hydrogen (certified total hydrogen carbons as methane <0.5 ppm recommended).

### NOTE

The hydrogen fill assembly contains a flow-limiting safety device. Approximately two minutes are required to fill the analyzer hydrogen tank.

\*\*\*\*\*  
\* WARNING \*  
\*\*\*\*\*

A safe refill operation means there are no hydrogen leaks. Before any valves are opened, use a wrench to firmly tighten (do not use excessive force) connections to the hydrogen supply tanks and the analyzer refill fitting. During the filling operation, if escaping hydrogen is heard (except during bleed), close all valves and correct the leak before proceeding.

1. The instrument and the charger should be completely shut down and detached from each other during hydrogen tank refilling operations. Refilling should be done in a ventilated area. THERE SHOULD BE NO POTENTIAL IGNITERS OR FLAME IN THE AREA.

2. If you are making the first filling on the instrument, or if the filling hose has been allowed to fill with air, the filling hose should be purged with hydrogen prior to filling the instrument tank. This purging is not required for subsequent fillings.

3. The filling hose assembly should be left attached to the hydrogen supply tank when possible. Ensure that the FILL/BLEED Valve is in the OFF position. Connect the hose to the refill connection on the Sidepack Assembly.

4. Open the hydrogen supply bottle valve slightly. Open the REFILL VALVE and the HYDROGEN TANK VALVE on the instrument panel, and SLOWLY set the FILL/BLEED Valve to the FILL position. The pressure will be indicated on the HYDROGEN TANK PRESSURE Indicator.

5. After the instrument fuel tank is filled, close the REFILL VALVE on the panel, then close the FILL/BLEED Valve, and finally close the hydrogen supply bottle valve.

6. The hydrogen trapped in the hose should now be bled off to atmospheric pressure. CAUTION should be used in the operation as described in Step 7 below, since the hose will contain a significant amount of hydrogen at high pressure.

7. The hose is bled by turning the FILL/BLEED Valve SLOWLY to the BLEED position. After the hose is bled down to atmospheric pressure, the FILL/BLEED Valve should be turned to the FILL position to allow the hydrogen trapped in the connection fittings to go into the hose assembly.

Then, again, turn FILL/BLEED Valve to BLEED position and exhaust trapped hydrogen. Then turn FILL/BLEED Valve to OFF to keep hydrogen at one atmosphere in hose so that at the time of the next filling there will be no air trapped in filling line.

8. Close the HYDROGEN TANK VALVE.

9. With HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE closed, a small amount of HYDROGEN at high pressure will be present in regulators and plumbing. As a leak check, observe HYDROGEN TANK PRESSURE Indicator while remainder of system is shut down and ensure that pressure reading does not decrease rapidly (more than 20 psi/hr) which would indicate a significant leak in the supply system.

## Battery Charging

\*\*\*\*\*  
\* WARNING \*  
\*\*\*\*\*

Never charge the battery in a hazardous environment.

### NOTE

If battery pack will NOT be used for a long period of time (one month, or more), then the instrument should be run off of the charger for an 8-hour period on a bi-monthly basis. This will ensure dependability of use for an 8-hour period, when needed.

## Normal Battery Charging Procedure

1. Plug charger connector into mating connector on battery cover, and insert ac plug into ac wall outlet, 110 V or 220 V, as indicated by setting of switch on rear of charger.
2. Move battery charger switch to ON position. The lamp above switch button should light, indicating that charger is receiving power.
3. The battery is charged when the yellow charge indicator lamp on the battery charger goes off.
4. Two hours of charging time is required for each hour of battery operation. A minimum of sixteen hours, however, is suggested after each battery use. When charging is complete (indicated by the yellow indicator lamp going off), move the battery charger switch to OFF and disconnect from the battery pack.
5. The battery pack should be left on charge as often as practical when not in use.

## SUMMARY OF OPERATING PROCEDURES

### Start-Up

1. Check battery condition by moving the INSTR Switch to the BATT position.

### NOTE

Fully charge battery, good test average reading is 7.6 to 8 on scale, not full scale.

2. Move INSTR Switch and PUMP Switch to ON and allow 5 minutes to warm up.

3. Use the Calibrate Adjust knob to set the meter needle to the level desired for activating the audible alarm. If this alarm level is other than zero, the Calibrate Switch must be set to the appropriate range.
4. Turn the Volume knob fully clockwise.
5. Using the Alarm Level Adjust knob, turn the knob until the audible alarm is activated.
6. Set CALIBRATE Switch to X10 position; use CALIBRATE knob and set meter to read 0.
7. Place the instrument panel in vertical position and check SAMPLE FLOW RATE indication. The normal range is 1.5 to 2.0 units. If less, check filters.
8. Open the HYDROGEN TANK VALVE and the HYDROGEN SUPPLY VALVE. Wait 2 to 3 minutes for flow before ignition.
9. Depress Igniter Button until flame ignites. Do not depress Igniter Button for more than four seconds. (If burner does not ignite, let hydrogen flow for one minute and again attempt ignition.)
10. Allow 20 minutes warm-up of P/A or listen for pop at exhaust port assembly chamber. Then, use CALIBRATE knob to "zero" out ambient background. For maximum sensitivity below 10 ppm, set CALIBRATE Switch to X1 and readjust zero on meter. To avoid false flame-out alarm indication, set meter to 1 ppm with CALIBRATE knob and make differential readings from there.

### Shutdown

1. Close the HYDROGEN SUPPLY VALVE.
2. Close the HYDROGEN TANK VALVE.
3. Move INSTR Switch and PUMP Switch to OFF.

### NOTE

Toggle Switch - switch handle must be pulled to change position. This prevents accidental movement.

4. Wait 5 seconds and move PUMP switch to OFF. Failure to do so will discharge the battery to a point where it will not retain a full charge. INSTRUMENT IS NOW IN A SHUTDOWN CONFIGURATION.

## CALIBRATION

### Primary Calibration for Methane

Internal electronic adjustments are provided to calibrate and align circuits. After initial factory calibration, it should not be necessary to repeat calibration unless analyzer undergoes repairs which affect calibration. If OVA 128 will be used extensively for analysis of a sample other than methane, recalibration of the electronics (after resetting the GAS SELECT dial) may result in better accuracy. See Recalibration to Various Organic Vapors above.

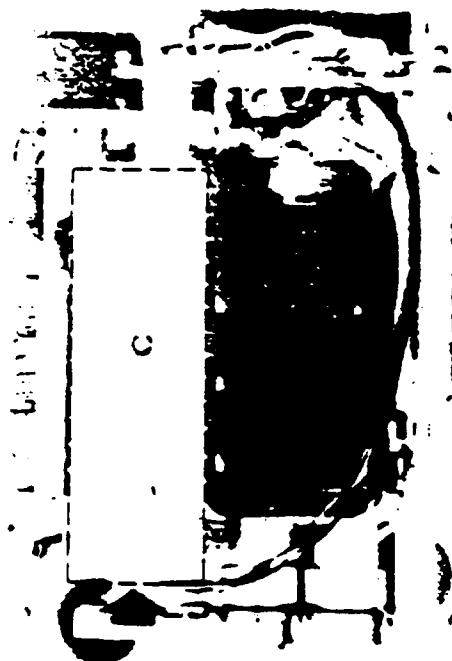
Primary calibration of this instrument is accomplished at the factory using methane-in-air sample gases. Methane-in-air calibration kits are available from Foxboro.

For more accuracy on the X100 scale, a 950 to 980 ppm sample of methane should be introduced. Fine tune R33 on printed wiring board assembly (see Figure 4).

### Calibration Using Known Samples for Each Range (Refer to Figure 4)

The accuracy stated under Specifications is obtained when the instrument is calibrated with known concentrations for each range. Prepare separate samples of Methane-in-air in these concentration ranges: 7 to 10 ppm, 90 to 100 ppm, and 900 to 1000 ppm. Calibrate the instrument as follows:

1. Place the instrument in normal operation and allow a minimum of 20 minutes for warm-up and stabilization; then zero out the ambient air.
2. Set the GAS SELECT dial to 300.
3. Set the CALIBRATE Switch to X10.
4. Set the CALIBRATE ADJUST (Zero) knob so that the meter reads zero.
5. Check that the meter reads zero on the X100 and X1 ranges.
6. Set the CALIBRATE Switch to X1 and introduce the sample with known concentration in the 7 to 10 ppm range.
7. Adjust R31 so that the meter reading corresponds to the sample concentration.
8. Set the CALIBRATE Switch to X10 and introduce the sample with known concentration in the 90 to 100 ppm range.
9. Adjust R32 so that the meter reading corresponds to the sample concentration.
10. Set the CALIBRATE Switch to X100 and introduce the sample with known concentration in the 900 to 1000 ppm range.



R-31 R-32 R-33 R-38

Figure 4.  
Location of Electronic Trimpot Adjustments

11. Adjust R33 so that the meter reading corresponds to the sample concentration.
12. The instrument is now calibrated for methane and ready for use.

### Calibration Using a Single Sample Calibration (Refer to Figure 4)

Calibration may be accomplished using a single known sample of methane in air in the range of 90 to 100 ppm. This may not provide the accuracy stated under specifications but is adequate for field survey work.

1. Place instrument in normal operation with CALIBRATE Switch set to X10 and GAS SELECT dial set to 300, and allow 20 minutes for warm up and stabilization.
2. Use the CALIBRATE ADJUST (zero) knob to adjust the meter reading to zero.
3. Introduce a methane sample of a known concentration (between 90 and 100 ppm, not to exceed 100 ppm) and adjust trimpot R32 so the meter reading corresponds to the known sample.
4. Extinguish the flame by blocking the exhaust ports.
5. Leave CALIBRATE Switch on X10 position and use CALIBRATE ADJUST (zero) knob to adjust Readout meter reading to 4 ppm.

6. Move the CALIBRATE Switch to the X1 position and using trimpot R31, adjust Readout meter reading to 4 ppm.
7. Move CALIBRATE Switch to X10 position again. Use CALIBRATE ADJUST (zero) knob to adjust Readout meter to 40 ppm.
8. Move CALIBRATE Switch to X100 position and use trimpot R33 to adjust Readout meter to 40 ppm.
9. Move CALIBRATE Switch back to X10 scale. Rzero Readout meter to 0 ppm; reignite instrument.
10. Unit is now balanced over the full range, calibrated to methane, and ready to be placed in normal service.

### Recalibration to Various Organic Vapors

#### NOTE

In order to reduce error, test sample must be prepared in the same background air as was present when the instrument was "zeroed".

The OVA 129 is capable of responding to nearly all organic compounds. At the time of manufacture, the analyzer is calibrated to mixtures of methane in air. For precise analysis it is necessary to recalibrate with the specific compound of interest. The GAS SELECT dial is used to set the electronic gain for a particular compound.

The instrument is recalibrated using a known concentration of a specific vapor in air. After the instrument is in operation and the normal background is zeroed, draw a sample of the calibration gas into the instrument. The GAS SELECT dial on the panel is then used to set the readout meter indication to correspond to the concentration of the calibration gas mixture.

The instrument has now been calibrated to the vapor mixture being used. After this adjustment, the setting on the GAS SELECT dial, and instrument serial number should be recorded for that particular organic vapor compound. This exercise can be performed for a large variety of compounds, thereby generating a "library" which can be used for future reference without need for additional calibration standards.

#### NOTE

Direct readout to the selected compound is valid only within the range in which the response is linear, and for the specific instrument for which calibration was performed.

To read a particular compound, the GAS SELECT dial is turned to the predetermined setting for the compound. Calibration on any one range automatically calibrates the other two ranges.

### Using Empirical Data

Relative response data can be used to estimate the concentration of a vapor without need to recalibrate the analyzer. With the instrument calibrated to methane, obtain the concentration reading for a calibration sample of the test vapor. The relative response (R) in percent for that vapor is:

$$R(\text{in } \%) = \frac{\text{Measured Concentration}}{\text{Actual Concentration}} \times 100$$

#### NOTE

The actual concentration can be determined by merely dividing the measured concentration by the relative response (expressed as a decimal).

The EPA quantifies detector sensitivity by utilizing a "Response Factor" for each compound, rather than a relative response in %.

where:

$$\text{Response Factor} = \frac{\text{Actual Concentration}}{\text{Measured Concentration}}$$

To determine the concentration of an unknown sample of that vapor, multiply the measured concentration by the Response Factor.

### Calibration Standards

#### Commercial Standards

Commercially available standard samples offer the most convenience and are recommended for the most precise analyses. Always remember to obtain the desired vapor in an ambient air background. Samples should be drawn from the cylinder into a collapsed sample bag, then drawn from the bag by the instrument to prevent a pressure or vacuum at the sample inlet.

## Calculations

Injection volume can be calculated by using the equation below.

$$\text{Injection} = \frac{(\text{Volume Concentration})(\text{Molecular Weight})(\text{System Volume})}{(\text{Density})(\text{Molar Volume at STP})} = \frac{(C)(MW)(V)}{(D)(V)}$$

Using the Ideal Gas Law,  $PV=RT$ , the molar volume of any gas at STP (25°C and 1 atm) is:

$$V = \frac{RT}{P} = \frac{(\text{Univ. Gas Constant})(\text{Temp.})}{\text{Pressure}} = \frac{(0.08206 \text{ litre atm}) (298.15 \text{ K})}{1 \text{ atm}} = (24.47 \text{ L}) (\text{mol}^{-1})$$

Therefore, injection volume necessary to prepare 1 Liter of a 100 ppm sample of hexane would be:

$$\text{Injection Volume} = \frac{(100 \text{ ppm})[(86.18 \text{ g})(\text{mol}^{-1})](1 \text{ Liter})}{[(0.659 \text{ g})(\text{mL}^{-1})][(24.47 \text{ L})(\text{mol}^{-1})][(1000 \text{ mL})(\text{L}^{-1})]} = 0.534 \mu\text{L}$$

\* STP - Standard Temperature and Pressure.

## SAFETY PRECAUTIONS

The OVA 128 has been tested and certified by Factory Mutual Research Corporation (FM) as safe for use in Class I, Division 1, Groups A, B, C, and D hazardous atmospheres. Similar foreign certifications have been obtained, including BASEEFA. Special restrictions must be strictly followed, to ensure that the certification is not invalidated by actions of operating or service personnel.

All flame ionization hydrocarbon detectors are potentially hazardous since they use hydrogen or hydrogen mixtures in the detector cell. Mixtures of hydrogen and air are flammable over a wide range of concentrations whether an inert gas such as nitrogen is present or not. Therefore, the recommended precautions and procedures should be followed for maximum safety. Safety considerations were a major factor in the design of the Organic Vapor Analyzer (OVA).

All connections are of the permanent type as opposed to quick disconnect. To protect against external ignition of flammable gas mixtures, the flame detection chamber has a porous metal flame arrestor on the hydrogen inlet connector. The battery pack and other circuits are internally current limited to an intrinsically safe level.

## No Modifications Permissible

It is imperative that operation and service procedures described in this manual be carefully followed in order to maintain the intrinsic safety which is built into the OVA. NO MODIFICATION TO THIS INSTRUMENT IS PERMISSIBLE. Therefore, component replacement must be accomplished with approved parts only.

## Electrical Protection

The 12 V battery power supply circuit is current limited to an intrinsically safe level. Fuses are not utilized and all current limiting resistors and other components which are critical to the safety certification are encapsulated to prevent inadvertent replacement with components of the wrong value or specification. Under no circumstances should the encapsulation be removed.

## Fuel Supply System

The OVA fuel tank has a volume of approximately 75 mL which, when filled to the maximum rated pressure of 2400 psig, holds approximately 5/8 ft<sup>3</sup> of gas. The fuel used in the OVA should be PREPURIFIED, LABORATORY grade or ZERO grade hydrogen (certified total hydrocarbons as methane <0.5 ppm recommended).

Hydrogen gas gains heat when expanding and, therefore, should not be rapidly released from a high pressure tank to a low pressure environment. Flow restrictors are incorporated in the hydrogen refill fitting and hydrogen is restricted on the output side of the tank by the low flow rate control system. In addition, a special flow restrictor is incorporated in the FILL/BLEED valve of the hydrogen filling hose assembly. These precautions limit the flow rate of the hydrogen to prevent ignition due to self-heat from expansion.

Precautions should be taken during hydrogen filling or hydrogen emptying operations to ensure that there are no sources of ignition in the immediate area. Since the instrument tank at 2400 psig holds only  $5/8$  ft<sup>3</sup> of hydrogen, the total quantity, if released to the atmosphere, would be quickly diluted to a nonflammable level. There is, however, the possibility of generating flammable mixtures in the immediate vicinity of the instrument during filling or emptying operations if normal care is not exercised.

### Detector Chamber

The flame ionization chamber has an input and output port. The input port has a mixer/burner assembly, and the output port has an exhaust port assembly. The chamber is ruggedly constructed of Teflon such that even if highly explosive mixtures of hydrogen and air are inadvertently created in the chamber and ignited, the chamber would NOT rupture.

### MAINTENANCE

This section describes the routine maintenance schedule and provides procedures for troubleshooting an instrument malfunction.

\*\*\*\*\*  
" CAUTION "  
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Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing, and maintenance, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emptying, or purging the hydrogen system, and the instrument should be turned off.

Extreme care should be exercised to ensure that required parts replacement is accomplished with the parts specified by Foxboro. NO MODIFICATIONS ARE PERMITTED. DISASSEMBLE INSTRUMENT ONLY IN A NONHAZARDOUS ATMOSPHERE.

### Routine Maintenance (Refer to Figure 5)

#### Primary Filter

This filter is located behind the sampler inlet connector (Fitting Assembly) on the Sidepack Assembly and is removed for cleaning by using 7/16 inch thin wall socket to unscrew the Fitting Assembly. The filter cup, O-ring, and loading spring will then come out. The porous stainless filter cup can be cleaned by blowing out or washing in solvent. If a solvent is used, care should be taken to ensure that all solvent is removed by blowing out or heating the filter. Reassemble in reverse order ensuring the O-ring seal on the Fitting Assembly is intact. Also, note that the spring does not go inside the cup filter. It mounts behind the filter against the solid end.

#### Secondary Filter

A particle filter is located in the close area sampler. This filter must be in the sample line whenever the instrument is in use. The QVA 128 uses a porous stainless steel cup filter which can be replaced or cleaned.

#### Mixer/Burner Assembly Filter

A porous bronze particle filter is incorporated in the Mixer/Burner Assembly which screws into the Preamp Assembly. This filter is used as the sample mixer and inlet filter into the P/A chamber. The filter should not become contaminated under normal conditions but can be cleaned, or the assembly replaced, if necessary.

#### Exhaust Flame Arrestor

A porous bronze flame arrestor is located in the exhaust port of the detector chamber (Preamp Assembly). It acts as a particle filter on the chamber output and restricts foreign matter from entering the chamber. This filter may be cleaned by removing the exhaust port (instrument switch must be OFF before removing). Note that the filter is captive to the exhaust port. Clean the filter with a solvent or detergent and ensure that it is dry and completely baked out (one hour) at 49°C (120°F) before reinstalling.

When reinstalling, ensure that flame arrestor is reinstalled fully into the chamber (must be grounded to preamp to operate properly). Also, reinstall the exhaust port cover.

#### Sampling Probes

Sampling probes should be periodically cleaned with an air hose and/or detergent water to eliminate foreign particle matter.

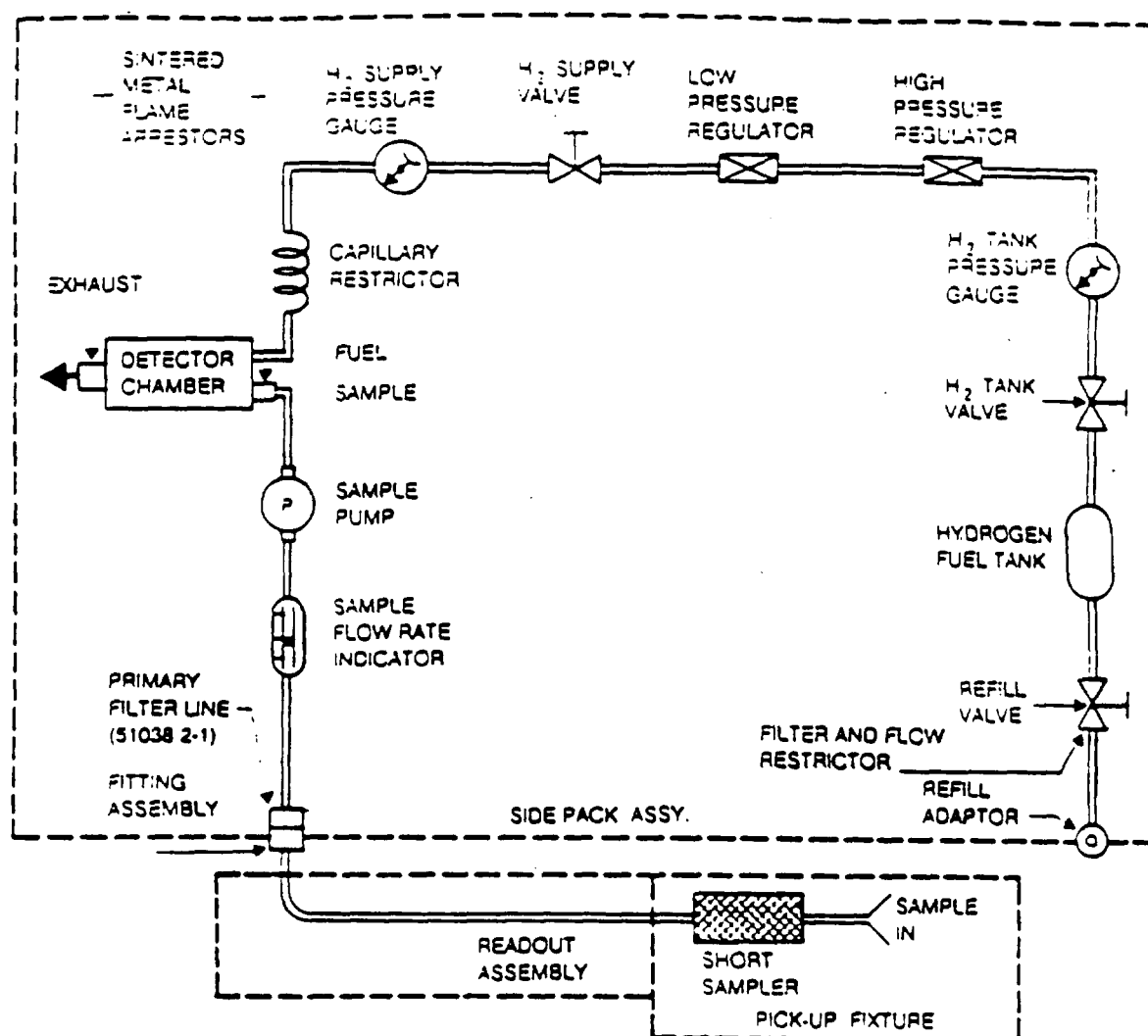


Figure 5. Block Diagram - Gas Handling System

If a solvent is used, the probe should be subsequently cleaned with detergent and baked out (one hour) at 49°C (120°F) to eliminate residual hydrocarbons from the solvent.

### Hydrogen Tank Supply and Refill Valves

After some time, the Teflon washers under each valve packing nut can "cold flow" (move with pressure) and allow hydrogen to leak. Leakage can be determined by using Leak-Tec or Snoop. This leakage can usually be stopped by rebuilding the high and low pressure regulators. These regulators can be rebuilt using KIT-G-510303 and Instruction MI 611-144.

### Air Sampling System Maintenance

A potential problem with the OVA instrument is that leaks can develop in the air sample pumping system. These leaks can result in dilution or loss of sample, causing low reading of vapor concentration and slow response.

The OVA is equipped with a flow gauge that provides a method to check for air leaks. Assemble the sample accessory selected for use to the Readout Assembly and then position the Sidepack vertically so the flow gauge may be observed. Cover the end of the sample probe and observe that the ball in the flow gauge goes to the bottom, indicating no air flow (if ball has slight chatter while on bottom, this is acceptable).

Failure of the ball to go to the bottom when the inlet is blocked indicates a leak in the system between the probe and the pump inlet or the inlet check valve. To isolate the problem, remove parts, one at a time, and again block off the air inlet. Remove the sample probe(s) and cover the air inlet at the Readout Assembly. If the ball goes to the bottom, check that the "readout to sample accessory" seal washer is in place and replace the probes, holding them back against this seal while tightening the nut. Recheck, and if leakage is still present, it is probably in the sample probe, which should then be repaired or replaced.



If leakage is indicated as being past the readout handle when the connection to the Sidepack is tight, disconnect the sample line at the fitting on the Sidepack and cover this inlet with your finger. If the flow gauge ball goes to the bottom, the problem should be a leak in the sample line assembly or sample tubing in R/O handle assembly, which should be investigated and repaired. There is also the possibility of a leaking check valve in the pump which would not show up on this test. If the leakage is not found in the sample line or sample tubing assembly in R/O handle, it is most likely in the pump check valve. The pump should be replaced.

If the ball does not go to the bottom, the leak will be either in the flow gauge or its connecting tubing. Visually check that the tubing is connected and if so, the flow gauge should be repaired or replaced. Check the O-ring installation in the sample inlet connector (Fitting Assembly).

As an alternate approach, leaks on the inlet side of the pump can be detected by using alcohol on a "Q" tip and lightly swabbing the connections one at a time, or by directing organic vapor or smoke at the potential leakage points and observing the meter response or audible alarm.

Leaks (beyond the pump) are easier to locate. Many of the commercially available leak detection solutions can be used. Cover the exhaust port, which will place the exhaust system under pressure, and check each connection, one at a time. Replace the Teflon tubing or retape the threaded connections with Teflon tape. Check the igniter and Mixer/Burner Assembly where they screw into the detector, the high voltage terminal lug on the side of the Mixer/Burner, and exhaust port itself. If after these checks, the flow gauge ball still will not go to the bottom with the exhaust blocked, the problem is likely a leaking exhaust check valve in the pump, which should be repaired or replaced.

## Contaminating Control

On occasion, the background reading may be relatively high under normal ambient conditions. Ambient background readings will vary somewhat depending on the geographical location where the instrument is being used. However, the background reading normally should be in the range of 1 to 5 ppm as methane. The acceptable background reading consists of 1 to 1 1/2 ppm of methane which is present in the normal air environment. In addition to the measurement of a normal methane background, there will normally be 2 to 4 ppm of equivalent methane background caused by acceptable levels of contamination in the hydrogen fuel and/or hydrogen fuel handling system resulting in a total equivalent methane reading of 3 to 5 ppm in clean air.

If the background reading goes above 5 ppm to 6 or 7 ppm, this is normally still acceptable since any measurement is additive to that background reading, i.e., 2 ppm on top of 5, or 2 ppm on top of 7 provides the same differential reading. However, the lower background is obviously desirable.

The background reading is zeroed out or nulled - even though in reality the background still exists. The background reading is measured by zeroing the meter with the flame out and noting the meter indication after the flame is on.

The cause for a high background reading is usually associated with contamination in the hydrogen fuel system, or a saturated short sampler. This will, of course, cause a background reading since this is the function of the basic detector "to measure contamination entering the detector chamber".

In addition, contamination present in the hydrogen will often leave a small unobservable deposit on the burner face which can continue to generate a background reading when the detector is in operation and the burner assembly is heated.

Another possible cause of contamination is the Mixer/Burner Assembly when the contamination is trapped in the porous bronze mixing filter. This is not a common problem and usually only happens when an unusually high level of contaminant is drawn into the assembly. Another possible cause of high background reading is contamination in the air sample line to the detector. This is uncommon but can be the source of the problem.

### NOTE

An OVA that has the Chromatograph Option can have high background caused by saturation or contamination of the activated charcoal scrubber, which is in the line during chromatograph analysis, or of the column which is in the hydrogen line at all times.

## Analysis and Correction

Prior to analyzing the problem, the OVA should be checked for proper electronic operation. It should be ensured that the instrument is calibrated to methane as referenced.

If, after checking that the OVA is properly calibrated, the background is still higher than normal for ambient conditions, the following procedure should be followed to isolate the cause of the problem:

1. Let the OVA run for a period of time (15 to 30 minutes) and see if the background level decreases as a function of time. The background could go down as a result of clearing line contamination which is removable simply by the normal flow of air through the sample line.

2. Take a reading in a known, relatively clean air environment. Normally, outside air environment is clean enough to assess by comparison whether the background reading is internal to the instrument or is present in the location where the instrument is being used.
3. If the OVA has the Gas Chromatograph Option, depress the sample inject valve, so that the activated charcoal scrubber is in the line, and observe whether the background reading goes down and stays steady after elution of the air peak. The reading should always go down or stay the same, but never increase, when the sample valve is depressed, since the activated charcoal scrubber will remove trace elements of organic vapors in the air sample heavier than  $C_2$ .

If another activated charcoal scrubber is available, this may be attached to the end of the probe to scrub the air so that a clean air sample is supplied to the detector. The external activated charcoal adapter can be used on any instrument, with or without the GC option, for providing a clean air sample to assess background level.

4. If the background cannot be reduced by any of the previous steps, remove the exhaust port cover (make sure that the instrument switch is OFF) and exhaust port of the detector chamber (on the bottom of the case) and clean the cavity and the electrode using the small wire brush supplied with the analyzer. This will remove any small quantities of contamination which could be the source of the background vapor. After cleaning, replace the exhaust port and exhaust port cover and reignite the OVA. If detector contamination was the cause, the problem should be immediately resolved and the ambient background will drop to an acceptable level.

5. If the high background is still present, the various parts of the sample flow line such as probes, sample line assembly to the instrument, etc., should be investigated by the process of elimination to see if the contamination can be isolated.

Serious contamination in the air sample line is very uncommon. However, if very large doses of low vapor pressure compounds are sampled, there is a possibility of residual contamination. This would eventually clear itself out but may take a considerable period of time. A typical cause for high background from the sample line is a contaminated close area sampler.

6. In the event of contamination in the pump or other internal parts of the sample flow lines which cannot be removed, the sample flow components have to be disassembled and cleaned. This is normally a factory operation; however, components such as the pump can be replaced in the field along with any contaminated tubing.

7. High background readings on OVA's which include the Gas Chromatograph Option can be caused by other sources of contamination. If the activated charcoal scrubber mounted on the instrument panel is saturated, contaminated air would be supplied to the detector and raise the ambient level background. To check for this, refill the cartridge with fresh charcoal, available from Foxboro. Purge the scrubber with nitrogen after replacing charcoal. This would determine if the charcoal was the source of the background reading. It is also possible that a high background reading could be due to contamination in the column, or contamination of Quad Rings with too much grease.

This could be caused by compounds slowly eluting from a column which has become contaminated. The easiest way to check for column contamination is to replace the column with a clean column or a short empty piece of column tubing and observe if the high background reading drops.

8. If the above steps do not correct the high background, the cause will normally be contamination in the hydrogen fuel system.

Contamination in the hydrogen fuel system is usually the direct result of contaminated hydrogen gas or contamination introduced during the filling operation. Filling hose contamination can be caused by storing the hose in a contaminated area.

\*\*\*\*\*  
" CAUTION "  
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Maintenance personnel should be thoroughly familiar with instrument operation before performing maintenance. It is essential that all portions of this manual relating to safety of operation, servicing, and maintenance, be thoroughly understood. There should be no potential igniters or flame in the area when filling, emptying, or purging the hydrogen system, and the instrument should be turned off.

Extreme care should be exercised to ensure that required parts replacement is accomplished with the parts specified by Foxboro. NO MODIFICATIONS ARE PERMITTED. DISASSEMBLE INSTRUMENT ONLY IN A NONHAZARDOUS ATMOSPHERE.

To remove contamination, the fuel system should be purged with hydrogen. Effective purging is accomplished by disconnecting the capillary tube fitting to the manifold block which has the low pressure gauge (Hydrogen Supply Pressure Gauge and Hydrogen Supply Valve). This disconnects the capillary tubing from the hydrogen line so that hydrogen may be purged at a reasonable rate from the tank assembly through the regulators, gauges, and valves. After disconnecting the capillary, the hydrogen tank can be filled in the normal manner. The tank valve and hydrogen supply valve can then be opened. This will bleed the hydrogen from the tank through the hydrogen fuel system, purging contamination which is in vapor form. There is the possibility that contamination has been introduced into the hydrogen fuel system which is not readily purged by the hydrogen gas, but this is unlikely. After purging with clean hydrogen two or three times, close the H<sub>2</sub> supply valve; then reconnect the capillary tube, reopen the H<sub>2</sub> supply valve, allow flow time, reignite instrument, and check the background again. Five or ten minutes should be allowed before assessing the background reading, since contaminated hydrogen can be trapped in the capillary tube.

If another clean instrument is available, the fuel system from the clean instrument can be connected to the contaminated instrument to verify whether the problem is associated with the hydrogen fuel supply system. The interconnection should be made to the capillary tube of the contaminated instrument.

## Recommended Spare Parts

The table below lists the recommended spare parts for the standard OVA 128 with a Basic Flame Ionization Detector (FID).

ITEM NUMBER	PART NUMBER	RECOMMENDED QUANTITY	DESCRIPTION
1	510461-1	2	Igniter
2	510221-6	1	Pump Assembly
3	620090 (5/pkg.)	1 pkg.	Cup. Filter (3/8 inch OD, ss)
4	510511-1	1	Mixer/Burner Assembly
5	CR007KA (12/pkg.)	1 pkg.	Wafer, Teflon
6	CR007KB (12/pkg.)	1 pkg.	Washer, Brass
7	510510-1	1	Flame Arrestor Assembly
8	510542-1	1	Battery Pack Assembly
9	CR010R0	1	Sample Line Assembly
10	CR007KJ (5/pkg.)	1 pkg.	Filter Sample Package (Tubular Sampler Only)
11	CR007KC (6/pkg.)	1 pkg.	Soft Valve Seat (for H <sub>2</sub> Valve Only)
12	KIT-G-510101	1	High and Low Pressure Regulator Repair Kit
13	CR010PM	1	Corrugated Tubing Cap
14	TR100JG	4 ft.	Corrugated Tubing
15	510496-1 (10/pkg.)	1 pkg.	Quad Rings (GC Units only)
16	CR007LL (10/pkg.)	1 pkg.	Readout Meter Seal

## Troubleshooting

Table 1 presents a summary of field troubleshooting procedures. If necessary, the instrument can be easily removed from the case by unlocking the four (4) 1/4-turn fasteners on the panel face, and removing the refill cap and igniter shield. Then disconnect R/O assembly and sample line assembly, and hold instrument up in vertical position. Lift instrument up, and out, by H<sub>2</sub> supply valve knob only. The battery pack is removed by taking out the four (4) screws on the panel and disconnecting the power connector.

## Factory Maintenance

To ensure continuous trouble-free operation, a periodic factory maintenance, overhaul, and recalibration is recommended. The recommended schedule is every six to nine months. This maintenance program includes replacement of plastic seals and parts as required, pump overhaul, motor check, sample line cleaning, hydrogen leak check, recalibration, and detailed examination of the unit for any other required maintenance and repair.

## Service Contracts

OVA Service/Maintenance Contracts are available. For more information, please call our Service Department at 508-378-5633.

Table 1.  
Summary of Troubleshooting Procedures for Standard OVA 128 with Basic FID

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
1. Low sample flow rate on flow indicator. Nominally 1.5 to 2.0 on flow gauge. (Also see 6 below.)	<p>a. Check primary filter in sidepack and particle filters in the sample probe.</p> <p>b. Determine assembly containing restriction by process of elimination, i.e., remove probe, short sampler, disconnect sample line assembly, remove primary filter, etc.</p> <p>c. If the restriction is in the Sidepack Assembly, further isolate by disconnecting the sample flow tubing at various points, i.e., pump output chamber, etc.</p> <p>NOTE: The inherent restrictions due to length of sample line, flame arrestors, etc., must be taken into account when troubleshooting</p>	<p>Replace or clean filter if clogged (P/N 620090, package of 5).</p> <p>Investigate the assembly containing this restriction to determine cause of blockage. Clean or replace as required.</p> <p>If in the detector chamber, remove and clean or replace porous metal flame arrestor. If pump is found to be the problem, remove and clean or replace.</p>
2. Hydrogen flame will not light. (Also see 6 below.)	<p>a. Check sample flow rate (see 1 above).</p> <p>b. Make sure that instrument switch is off. Then check igniter by removing chamber exhaust port and observing the glow when the IGNITE BUTTON is depressed.</p> <p>c. Check for rated Hydrogen Supply Pressure. (Listed on calibration plate on pump bracket.) Reading should be between 10 and 12 psi.</p> <p>d. Check hydrogen flow rate by observing the psi decrease in pressure on the Hydrogen Tank Pressure gauge. The correct flow rate will cause about 100 to 150 psi decrease in pressure per hour. (Approximately 12 mL/min at detector.)</p> <p>e. Check all hydrogen plumbing joints for leaks using liquid Snoop only. Also, shut off all valves and note pressure decay on hydrogen tank gauge. It should be less than 20 psi per hour.</p>	<p>If sample flow rate is low, follow procedure 1 above.</p> <p>If igniter does not light up, replace the plug. If igniter still does not light, check the battery and wiring.</p> <p>If low, remove battery pack and adjust to proper level by turning the allen wrench adjustment on the low pressure regulator cap.</p> <p>The most likely cause for hydrogen flow restriction would be blocked or partially blocked capillary tube. If flow rate is marginally low, attempt to compensate by increasing the Hydrogen Supply Pressure by one-half or one psi. If flow rate cannot be compensated for, replace capillary tubing (P/N 510073-1).</p> <p>Repair leaking joint.</p>

Table 1. (Cont.)

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
	<p>f. Check to see if hydrogen supply system is frozen up by taking unit into warm area.</p> <p>g. Make sure that instrument switch is off first; then remove exhaust port and check for contamination.</p> <p>h. Check spacing between collecting electrode and burner tip. Spacing should be 0.125 to 0.15 inches.</p>	<p>If there is moisture in the hydrogen supply system and the unit must be operated in subfreezing temperatures, purge the hydrogen system with dry nitrogen and ensure the hydrogen gas used is dry.</p> <p>If contaminated, contact Foxboro for service.</p> <p>Adjust by screwing Mixer/Burner Assembly in or out. This spacing problem should only occur after assembling a Mixer/Burner Assembly to a Preamp Assembly.</p>
3. Hydrogen flame lights but will not stay lighted.	a. Follow procedures 2(a), (c), (d), (e), (g), and (h) above. Also refer to 5 below.	---
4. Flame-out alarm will not go on when hydrogen flame is out.	<p>a. Check instrument calibration setting and GAS SELECT control setting.</p> <p>b. Remove exhaust port and check for leakage current path in chamber (probably moisture or dirt in chamber).</p> <p>c. If above procedures do not resolve the problem, the probable cause is a malfunction in the preamp or power board assemblies.</p> <p>d. Check that volume control knob is turned up.</p> <p>e. Instrument switch is off.</p>	<p>Readjust as required to proper setting. Note that the flame-out alarm is actuated when the meter reading goes below zero.</p> <p>Clean contamination and/or moisture from the chamber using a swab and freon or alcohol. dry chamber by running pump for approximately 15 minutes.</p> <p>If spare is available, then replace. If not, return preamp assembly or power board replacement assembly to the factory.</p> <p>Adjust for desired volume.</p>
5. False flame-out alarm.	a. Flame-out alarm is actuated when signal goes below electronic zero (with flame on). This can be due to inaccurate initial setting, drift, or a decrease in ambient concentration. Verify if this is the problem by zeroing meter with flame out and reigniting.	When using the X1 range, adjust meter to 1 ppm rather than zero; be sure instrument has been zeroed to "lowest expected ambient background level".

Table 1. (Cont.)

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
5. Slow response, i.e., time to obtain response after sample is applied to input is too long (i.e., > 2 seconds).	a. Check to ensure that probe is firmly seated on the rubber seal in the readout assembly.  b. Check sample flow rate per procedure 1 above.	Reseat by holding the probe firmly against the rubber seal and the lock in position with the knurled locking unit.  See 1 above.
7. Slow recovery time, i.e., too long a time for the reading to get back to ambient after exposure to a high concentration of organic vapor. (i.e., > 6 seconds).	a. This problem is normally caused by contamination in the sample input line. This requires pumping for a long period to get the system clean of vapors. Charcoal in the lines would be the worst type of contamination. Isolate through the process of elimination. See 1(b).  b. Check preamp chamber for contamination.	Clean or replace contaminated sample line or assembly as required.  If contaminated, contact Foxboro for service; otherwise, clean as required. Preamp should be removed before cleaning.
8. Ambient background reading in clean environment is too high.	a. A false ambient background reading can be caused by hydrocarbons in the hydrogen fuel supply system. Cover the end of the sample probe to restrict sample flow. If meter indication does not go down significantly, the contamination is probably in the hydrogen fuel.  b. A false ambient background reading can also be caused by a residue of sample building up on the face of the sample inlet filter. If the test in 8(a) above produces a large drop in reading, this is usually the cause.  c. A false ambient background reading can also be caused by hydrocarbon contamination in the sample input system. The most likely cause would be a contaminant absorbed or condensed in the sample line. NOTE: It should be emphasized that running the instrument tends to keep down the buildup of background vapors. Therefore, run the unit whenever possible and store it with the carrying case open in clean air.	Use a higher grade of hydrocarbon free hydrogen. Check for contaminated fittings on filling hose assembly. Or short sampler may need cleaning.  Clean and/or replace the sample input lines. Normally the false reading will clear up with sufficient running.
9. Pump will not run.	a. Visually check for loose wires.  b. Pump eccentric assembly hanging up.  c. Sample inject partially engaged.	If no loose wires, pump motor is defective.  Replace pump. If spare pump not available, return pump to Foxboro for service.

Table 1. (Cont.)

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
10. No Power to electronics but pump runs.	a. Broken wires on R/O connector (Foxboro P/N 12749). b. Printed Wiring Board is partially unplugged.	Replace or repair broken wire. Reseat board properly.
11. No power to pump or electronics.	a. Connect readout meter and perform battery test. b. Place battery on charger and see if power is then available. Recharge in a nonhazardous area only.	If power is available, battery pack is dead or open. Recharge battery pack. If still defective replace battery pack.

NOTE. If the procedures in Table 1 do not rectify the problem, contact Foxboro for further information.

## GAS CHROMATOGRAPH (GC) OPTION

The Model OVA 128 CENTURY Organic Vapor Analyzer provides efficient and accurate indication of total organic compound concentrations on a continuous sampling basis. However, in areas where mixtures of organic vapors are present, it often becomes necessary to determine the relative concentration of the components and/or to make quantitative analysis of specific compounds.

To provide this capability, a gas chromatograph (GC) option is available. See Figure 6 for the location of the major components and controls associated with the GC option. When the GC option is used, the capability of the OVA includes both qualitative and on-the-spot quantitative analysis of specific components present in the ambient environment. The optional Recorder, which is used with the GC option, is described separately.

This section is applicable only to an OVA with the optional gas chromatograph system.

## Modes of Operation

The OVA with GC option has two modes of operation. The first mode is the measurement of total organic vapors in the same manner as described for the basic OVA instrument. This mode is referred to as the "Survey Mode". The OVA is in the "Survey Mode" of operation whenever the Sample Inject Valve is in the completely "OUT" position and the back flush valve is also in the "OUT" position.

The second mode of operation is called the "GC Mode". The OVA is in this mode of operation any time a sample has been injected (sample injection valve is in the "IN" position) into the GC system and the sample is being transported through the GC column. This section provides a brief description of how a gas chromatograph (GC) operates and specifically, how the OVA 128 performs the required operations. A comprehensive discussion of gas chromatography theory, column selection, and data analysis is beyond the scope of this manual.

The OVA with GC option can be utilized for many types of analysis in the outdoor or indoor ambient environment or for specific laboratory type analysis. The OVA was not designed to compete with the research or process gas chromatographs but to complement these instruments, or eliminate their need in field applications.

This manual is intended to provide the operator with information to operate and maintain the OVA. Foxboro publishes Laboratory Application/Technical Notes to assist the operators in applying the instrument to field monitoring situations.

All flame ionization detector (FID) gas chromatographs require certain elements for their operation. These elements include three flow regulated gas supplies as follows: 1) A carrier gas to transport the sample through the column; 2) Hydrogen gas for operation of the FID; 3) A clean air supply to support combustion to the FID. In addition, a method for injecting a known volume of sample air (aliquot) to be analyzed is required.

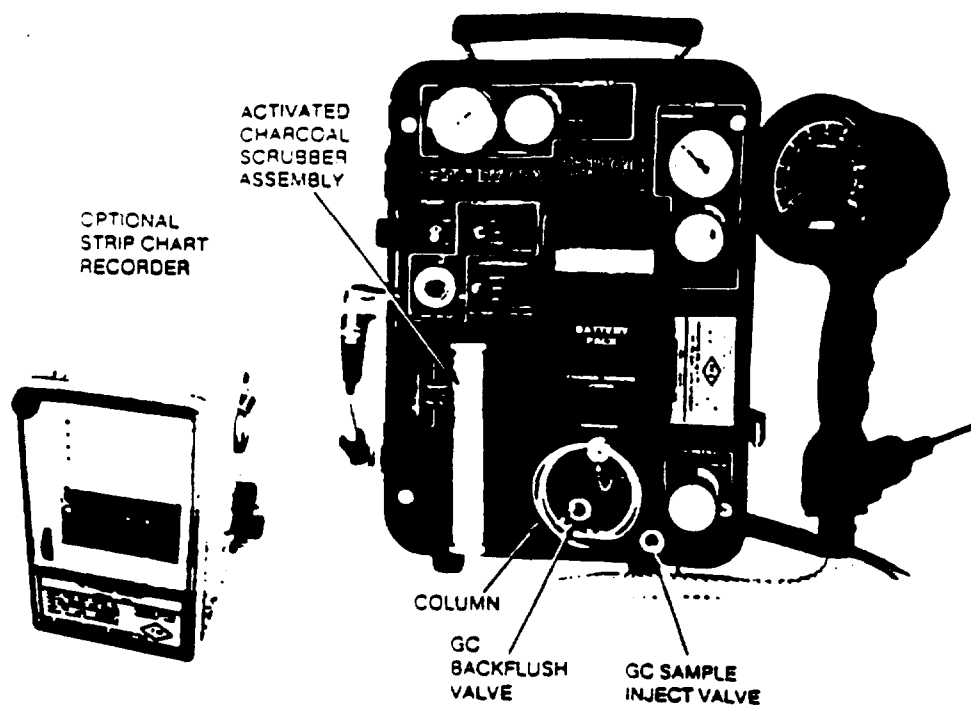


Figure 6. Additional Controls and Components - GC Option

In standard gas chromatographs these three (3) flow regulated gases are individually supplied from pressurized cylinders equipped with regulators and flow control apparatus. The Model 128 GC system differs in that the hydrogen fuel for the FID is also used as the carrier gas. The clean air supply is simply the normal sample air pumped to the FID. During the GC analysis, this air is scrubbed in an activated charcoal scrubber to provide the clean air supply. The end result is that no additional gas supplies are required to add the GC option to the basic OVA instrument.

A valving arrangement is incorporated to provide a method for transferring a fixed volume of air and sample into the GC system for analysis. The sample air injected into the GC column is the same sample being analyzed by the OVA for total organic vapor concentration. Therefore, the instrument provides the unique capability to observe the total organic vapor concentration of the sample prior to injecting it into the GC system. This operating feature is invaluable in field work where the environment is continually changing and where valuable GC analysis time must be expended only on the sample of concern.

### OVA Columns

Columns are available in 4, 8, 12, 24, 36, and 48 inch lengths as standard offerings with any of the column packings listed in the Column Packings Table. Longer lengths are available in 12-inch increments on a nonstandard basis. To order a column, simply use the general Part Number for a column (510454) followed by a

dash (-), the Foxboro packing material designation (see table below), a second dash and the desired length in inches. A sample column designation is 510454-G-24. This would represent a 24-inch column with 10% OV-101 on Chromosorb W, HP 60/80 mesh. If a specific application arises which calls for a column material not listed, please contact Foxboro. We will be happy to check on its availability.

Table of Column Packings

FOXBORO DESIGNATION	MATERIAL
A	20% Dioctyl Phthalate on Chromosorb-P, AW 60/80 Mesh
C	Chromosorb 101, 60/80 Mesh
D	20% Ucon 50 HB 280 on Chromosorb-P, AW 60/80 Mesh
E	20% Carbowax 400 on Chromosorb-P, AW 60/80 Mesh
F	5/1.75% Diethylhexyl Sebecate/Bentone 34 on Chromosorb W, AW 60/80 Mesh
G	10% OV-101 on Chromosorb W, HP 60/80 Mesh
T	10% 1,2,3.-Tris (2-cyanoethoxy) Propane on Chromosorb P, AW 60/80 Mesh
B	3% Diisodecyl Phthalate on Chromosorb W, AW 60/80 Mesh
PT	Poropak T, 60/80 Mesh
Q	Poropak Q, 60/80 Mesh
H	10% Carbowax 20M on Chromosorb P, AW 60/80 Mesh
J	n-Octane on Porasil C, 80/100 Mesh
N	Poropak N, 60/80 Mesh



## Sample Flow

Figure 7 is a flow diagram illustrating the flow paths of the hydrogen fuel, sample air supply, and the sample aliquot injected for GC.

Two push-pull valves are used in the GC system: the Sample Inject Valve and the Backflush Valve.

Block D illustrates the flow paths with the Sample Inject Valve in the "OUT" position. With this valve in the "OUT" position, the OVA functions in its normal manner as a total organic vapor analyzer.

Block C illustrates the flow paths after the Sample Inject Valve is moved to the "IN" position to initiate the GC Mode.

The hydrogen flow path is now through the sample loop which enables hydrogen to sweep the air sample from the loop and carry it through the GC column.

Also note that the sample air going to the FID chamber is now routed through the activated charcoal scrubber where essentially all organic vapor contamination is removed from the air. The activated charcoal scrubber will effectively absorb most organic vapors with the exception of methane and ethane. The functions of the Sample Inject Valve are, therefore, to transfer a fixed volume sample of the air being monitored into the hydrogen stream and to reroute the sample air supply through an activated charcoal scrubber.

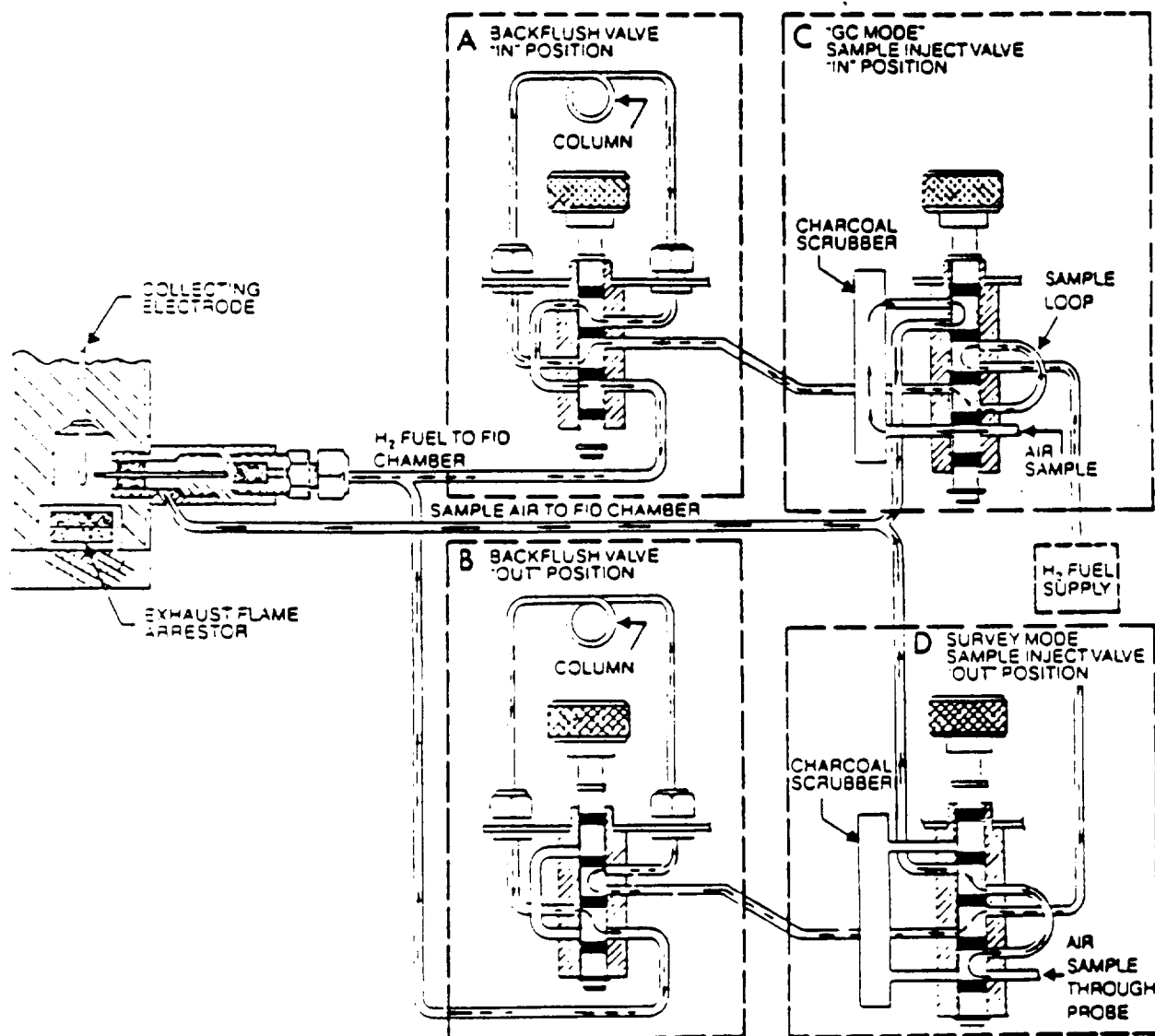


Figure 7. Flow Diagram - GC Option

The Backflush Valve has no prepositioning requirement to function. It can be in either the "IN" or "OUT" position at the time a sample is injected into the GC system for analysis. The Backflush Valve simply reverses the direction of the hydrogen flow through the GC column.

Regardless of the operating mode, hydrogen always flows through the column to the FID detector and the sample air supply always flows to the FID detector to provide oxygen for the hydrogen flame.

The recommended hydrogen flow rate is  $12.0 \pm 0.5$  mL/min (GC models) for proper FID operation and as a standard flow rate for generating GC reference/calibration data. This hydrogen flow rate is adjusted by varying the Hydrogen Supply Pressure, which is the hydrogen pressure at the input of the flow control capillary tube of the OVA. The pressure is changed by adjusting the set screw in the bonnet of the low pressure regulator, accessible by removing the battery pack from the instrument panel. To monitor the hydrogen flow rate, connect a bubble flowmeter to an end of the GC column which has been disconnected from the panel fitting and move the Backflush Valve so that hydrogen is flowing out of the column. Primary hydrogen flow control is accomplished by the capillary tube of the OVA. However, the flow restriction of a GC column will also affect the hydrogen rate and the effect will vary with column length, type of packing, and packing

methods. The nominal Hydrogen Supply Pressure is around 12 psig, and the pressure drop across a typical 24-inch long column packed with 60/80 mesh material is approximately 1 to 1.5 psig. Normally, when the hydrogen flow rate is set at 12 cm<sup>3</sup>/min with a standard 24-inch long column, no adjustment needs to be made when using columns from four (4) inches to four (4) feet long. Longer columns may require hydrogen flow adjustment for proper operation. Adjustment would be required if and when precisely controlled analysis was being conducted or when the hydrogen flow was too low to keep the flame burning.

The sample air flow rate is not adjustable and is nominally 1 L/min. This flow rate should remain relatively constant. A sample flow gauge is provided on the OVA panel to monitor the sample flow rate.

#### NOTE

Panel gauge is not calibrated in L/min.

When the Sample Inject Valve is in the "IN" position, there may be a slight increase or decrease in sample air flow rate (0 to 15%). This change will normally not affect operation of the instrument as long as the flow rate is consistent from analysis to analysis. Basically, if the flow rate is consistent between calibration and end usage, there will be suitable precision in the measurements.

## GC Analysis

### Sample Injection

When the Sample Injection Valve is depressed, the air in the sample loop is injected into the hydrogen stream which transports the sample through the column for separation of its components and to the flame chamber for detection. This small volume of injected sample is qualitatively analyzed based on the retention time of the individual components of that sample while passing through the column. Quantitative analysis can then be accomplished by peak height or peak area analysis methods.

### Column

The column consists of tubing packed with a material which physically interacts with organic vapors and retards the passage of the vapors through the column. Since the packing material has a different attraction for each organic substance, each component in a mixture of gases will be slowed down to a different extent. See Figure 8.

The net effect is that each component elutes from the column at a different time. The components are then fed to the detector which gives a response to the meter or to an external strip chart recorder.

A portable isothermal pack (PIP) can be used for temperature maintenance and/or isothermal analysis. This is described further under PIP kit option.

## Qualitative Analysis

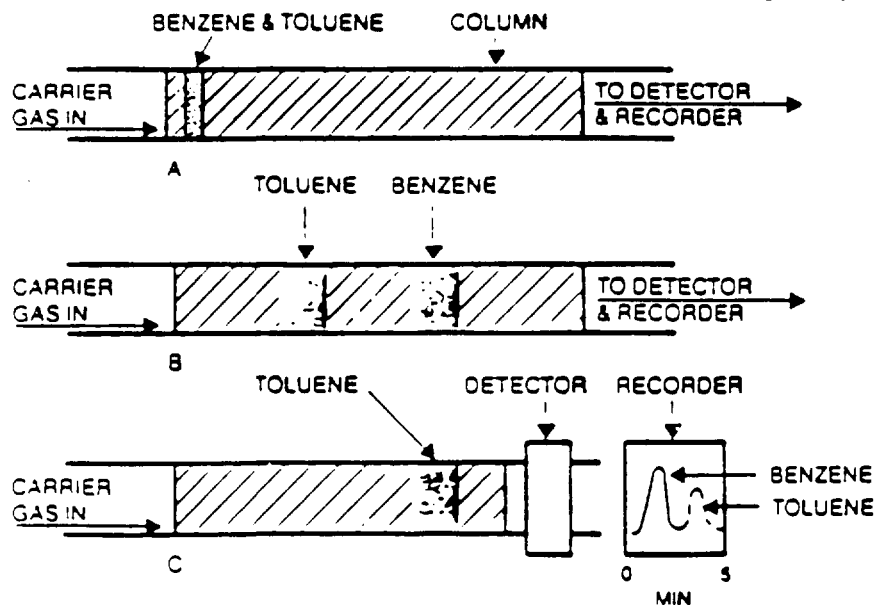
As each organic substance has a unique interaction with the column packing material, the time that the substance is retained on the column is also unique and thus characteristic of that particular substance. The "retention time" (RT) is primarily dependent on the type of packing material, the length of the column, the flow rate of the gas carrying the mixture through the column, and the temperature range of the system.

When these variables are controlled, the retention times can be used to identify each of the components in a mixture. Because of these variables, it is usually necessary to establish retention times for each instrument by making a test with the pure substances of interest or to refer to established time data charts prepared in advance for that specific instrument. In those cases where retention times of the components are too close together for a good analysis, an adjustment in one or more of the operating variables will usually effect a sufficient difference in retention times to enable a meaningful analysis.

## Quantitative Analysis

The detector response to any organic component is proportional to the quantity of material passing through the detector at a given time. For an eluted component, a plot of concentration vs. time forms a bell-shaped curve.

When using a strip chart recorder, the curve drawn on the paper is triangularly shaped and the area under the peak is related to the amount of substance being analyzed.



PICTORIAL SEPARATION OF BENZENE AND TOLUENE - "A" AT BEGINNING OF SEPARATION; "B" DURING SEPARATION; "C" BENZENE HAS ALREADY PASSED THE DETECTOR AND IS RECORDED. TOLUENE (DOTTED LINES) WILL APPEAR ON RECORDER AS IT PASSES THE DETECTOR.

Figure 8. Typical Column Separation Sequence

## Backflush

The column Backflush Valve is provided to reverse the direction of flow of the carrier gas (hydrogen) through the column. It is necessary that the column be backflushed after each individual analysis except under certain special conditions. The primary purpose of the backflush function is to clear the column of heavy compounds (with long retention times) which would contaminate the column and cause interferences to future GC analysis. The Backflush Valve has no prepositioning requirement; it is reversed from either position it was in during GC analysis. The Backflush Valve should be actuated immediately after the peak of the last compound of interest elutes. Figure 7 illustrates the function of the Backflush Valve.

In the GC system, the backflush is "to the detector". This is possible because the carrier gas and detector fuel are the same, i.e., hydrogen. It provides a convenient means of quantifying the total compounds in the backflush by simply recording the peak that elutes during the backflush operation. For field instruments, this quantitative backflush information is valuable since it provides a direct means of observing the condition of the column, seeing when the column is clean, and noting when the detector response has returned to baseline. The time required for backflush is usually 1.2 to 1.5 times the GC analysis time.

## Survey to GC Mode

There is an inherent advantage to integrating the GC system to the basic total Organic Vapor Analyzer (OVA). The OVA provides a direct reading of total organic vapors in the air being sampled, which gives the operator information about the sample being injected into the GC system. This information can be used to predict and verify the peaks that result during the GC analysis, including the backflush peak.

This feature eliminates expending valuable GC analysis time where there is no contamination of concern (comparable to taking noise measurements in quiet corners). It also enables the operator to select the most appropriate location to conduct an analysis, normally the area of highest concentration.

## GC MODE OPERATING PROCEDURES

The gas chromatographic analysis mode (GC Mode) of operation can be initiated at any time during a survey by simply depressing the Sample Inject Valve. After completion of the analysis and backflush operations, the Sample Inject Valve is pulled out and the survey continued or another sample injected. Note that when the Sample Inject Valve is in the survey mode (out position), the OVA operates in the same manner as an OVA which does not incorporate the GC option.

## Controls/Indicators (Figure 6)

### Sample Inject Valve

This 2-position valve (shown schematically in Figure 7) is used to select either Survey Mode (valve out) or GC Mode (valve in).

### Backflush Valve

This 2-position valve (shown schematically in Figure 7) is used to reverse the flow of hydrogen through the column to:

1. Backflush the column for cleaning.
2. Quantitatively measure total compounds after a selected point. Example:  
Separation of methane from non-methane hydrocarbons to read total non-methane hydrocarbon level.

### Column

Separates components of a gas mixture so that each component of the mixture elutes from the column at a different time.

## Activated Charcoal Scrubber Assembly

This assembly functions only in the GC Mode (sample Inject Valve "IN") as shown schematically in Figure 7. It removes organic compounds (except methane and ethane) by absorption from the sample air supply.

## Turn On Procedure

Place the Sample Inject Valve in the "OUT" position and put the OVA instrument in operation per "Operating Procedures - Survey Mode" section.

### NOTE

Leave the hydrogen fuel and pump "ON" for three to four minutes before attempting ignition to allow time for hydrogen purging of the column.

## Survey Mode

When using the OVA in the Survey Mode, ensure that the Sample Inject Valve remains in the full "OUT" position and that the Backflush Valve is either full "IN" or full "OUT". Note that when changing from the GC Mode to the Survey Mode, the OVA output reading will continue to change until all compounds have been eluted from the GC column. Therefore, under normal field conditions, the GC column should be backflushed for clearing, which takes approximately 1.2 to 1.5 times the forward analysis time. The backflush peak may be observed returning to baseline, after which the Sample Inject Valve may be moved to the Survey Mode (OUT) position.

When the compound(s) being analyzed are known to be the only compound(s) present in the air sample, backflushing may be omitted.

## GC Mode Operation

In normal GC analysis, a strip chart recorder is used to record the output concentration from the OVA as a function of time. This record, called a chromatogram, is utilized for interpretation of the GC data.

### OPERATION --

1. Turn on recorder and push Sample Inject Valve "IN" with a fast, positive motion. This starts the GC analysis, which is automatic up to the point of backflushing.

### NOTE

Rapid and positive motion should be used when moving either Sample Inject or Backflush Valves.

On occasion, the flame in the FID detector may go out, which would be indicated by a sharp and continued drop of the concentration level. If this occurs, reignite the flame and continue the analysis:

### NOTE

A negative "air" peak typically occurs shortly after sample injection and should not be confused with flame-out.

2. The negative air peak and various positive compound peaks indicated on the OVA readout meter and the strip chart recorder represent the chromatogram.
3. After the predetermined time for the analysis has elapsed (normally immediately after the peak of the last compound of concern), rapidly move the Backflush Valve to its alternate position (in or out). Leave the instrument in this condition until the backflush peak returns to baseline, then pull the Sample Inject Valve to the "OUT" position. If no backflush peak appears, pull the Sample Inject Valve out after being in the backflush condition for a period at least twice as long as the analysis time. The OVA is now in the Survey Mode and ready for survey or injection of another sample into the GC system.

INTERPRETATION OF RESULTS -- The OVA 128 with GC option is intended for applications where there are a limited number of compounds of interest and the compounds are normally known. Under these conditions, the operator must know the retention time and peak height characteristic of the compounds under specific operating conditions. To calibrate the OVA in the GC Mode, determine, by test, the retention time and peak area (using peak height analysis) for the compounds of concern. These tests should be conducted on the column to be utilized and over the concentration and temperature range of concern. When representative characteristic data is available, such as in the Laboratory Application/Technical Notes, a spot calibration check is normally all that is required.

It should be noted that under normal field conditions, the vapor concentrations vary continually as a function of time, location, and conditions. Field measurements for industrial hygiene work are normally associated with a threshold level around a preestablished concentration. Surveys for locating fugitive emission sources present a continually varying situation. Under these conditions, it is desirable to have a simple method of interpreting the GC data for on-the-spot analysis and decision making.

High precision is normally not a requirement for these types of analyses, since the environment is continually changing. The methods presented in this section are designed to provide means for typical field analysis. When the OVA is used under laboratory conditions, standard laboratory methodology may be used for greater precision.

## Technical Discussion

The chromatogram is a chart-recorded trace of the organic vapor concentration from the Organic Vapor Analyzer (OVA) as a function of time. A typical chromatogram is illustrated in Figure 9 and is a series of triangular peaks originating from and returning to a fixed baseline. Qualitative interpretation of a chromatogram involves identifying a peak by analyzing the time it took for the peak to appear after initial injection [referred to as retention time (RT)] and comparing the RT to reference data. Quantitative interpretation involves analyzing the area under the peak and relating this area to calibration data of peak area versus concentration for that specific compound under the conditions present during the GC analysis.

It can be seen that interpretation of a chromatogram requires the use of calibration reference data. GC reference data is always generated empirically, i.e., through tests. Foxboro Laboratory Application/Technical Notes may be used as a reference for selecting columns and interpreting chromatograms. However, simple tests must be conducted to obtain the required reference data.

**QUALITATIVE ANALYSIS** -- Under a given set of operating conditions the retention time is characteristic of that particular substance and can be used to identify specific compounds. It will be necessary to calibrate retention times by making tests with the pure compounds of interest.

The retention time (RT) is defined as that period of time from injection until the time of maximum detector response for each substance. Retention time is measured from the time of sample injection to the time the apex of the triangular curve is obtained on the strip chart recorder. (See Figure 9.) The strip chart recorder operates on a clock mechanism such

that the distance along the baseline is proportional to time. While retention times are characteristic for each compound, it is possible that two materials could have the same retention times. Thus, if there is any question as to the identity of the vapor, it may be necessary to verify identification by retention times on different columns.

Use of a longer column will increase the retention times of those components it is capable of separating. The time between peaks will also be increased. This is especially useful if a component comes through too fast or if desired peaks are so close that they overlap.

**COLUMN SELECTION** -- Two columns are supplied with the instrument. These are general purpose columns which are useful in a wide variety of applications. If they do not achieve separations for a particular application, it may be necessary to select other packing material or longer columns. Foxboro will assist in this selection or prepare a custom column if necessary.

If columns are made by the user or purchased from other sources, ensure that the packing density does not create too large a pressure drop. A large pressure drop can result in flame-out problems.

**TEMPERATURE EFFECT ON RETENTION TIME** -- An increase in temperature will decrease column retention time (RT) and vice versa. Normally, retention time (RT), as a function of temperature, changes linearly over the range of 0 to 40°C. For complex qualitative analysis, a calibration plot of RT versus temperature will be required. In typical usage, such as inside a factory, the effect of temperature can be compensated for during chromatogram interpretation. A single component tracer compound can be sampled at any time to provide a "key" for other compound identification.

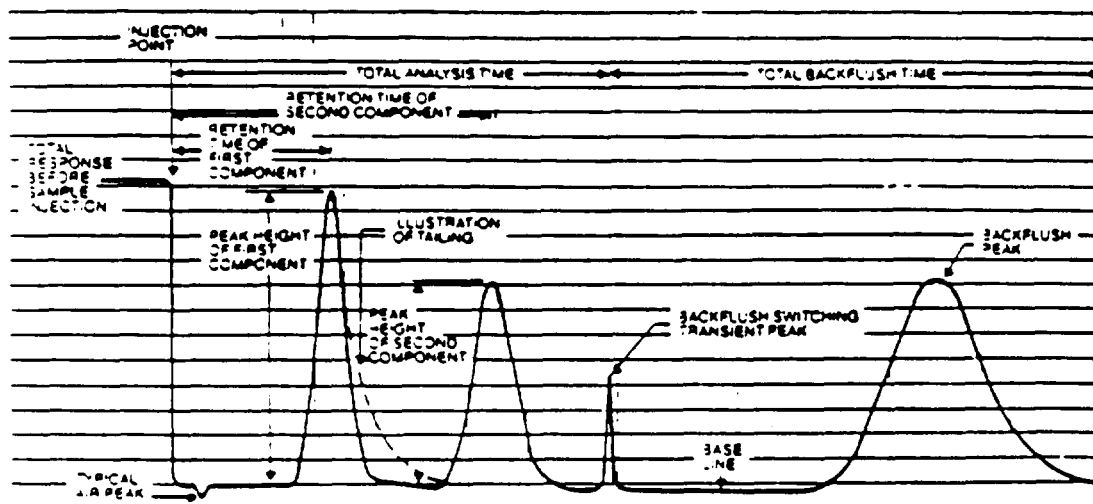


Figure 9. Typical Chromatogram

#### CARRIER GAS FLOW RATE EFFECT ON RETENTION TIME

-- An increase in carrier gas flow rate will decrease retention time. For reproducible data, the carrier gas (hydrogen) flow rate must be recorded in association with a chromatogram. Primary control of hydrogen flow rate is accomplished in OVA by regulating the hydrogen supply pressure across a capillary tube. The hydrogen flow rate is also affected by restriction of the GC column, but most columns have a limited effect. The hydrogen flow rate is factory set at 12 cm/min with a typical 24-inch column.

QUANTITATIVE ANALYSIS -- In general, the more triangularly symmetrical the peak, the better the peak height analysis capability. However, many GC peaks have "tailing" as illustrated in Figure 9. Peak height calibration is an acceptable method for quantitative analysis as long as the area under the tail is small compared with the total peak area. If severe tailing occurs, empirical calibration data generated through tests may be required to plot the peak height versus the concentration curve.

Only peak height analysis will be discussed in this manual. The method involves injecting a known concentration of the compound and recording the peak height under the test conditions. Peak height characteristics can be established for various columns and various temperatures. Normally, both retention time and peak height characteristic will be measured.

When peak area measurements are desired, the areas may be measured using an integrator on the OVA output signal. Other manual methods may also be used, such as counting squares, weighing curves, or simple triangulation. When GC peaks have good symmetry, triangulation (area equals  $1/2$  base  $\times$  height) is a convenient method.

### Calibration Data

When conducting tests to obtain GC calibration data, the following information should be recorded.

1. Column - description and serial number as applicable.
2. Temperature - column temperature, normally ambient.
3. Chart Speed - distance/unit time.
4. Carrier Flow Rate - hydrogen flow rate through the column (cm/min).
5. Sample Concentration - ppm for each compound
6. Sample Volume - 0.25 mL for factory standard installed loop.
7. Range - range of OVA being used, i.e., X1, X10, X100.
8. OVA Serial Number.

To obtain a calibration point, inject a known concentration sample into the GC system and record the resulting chromatogram peak. The retention time for the peak may be determined from the record or timed with a stop watch. The peak height may be measured from the record. Figure 11 presents the format of a chart which may be used to record calibration data. Experience has indicated that the peak height response of a compound is linear within the concentration range of 0 to 160 ppm. Therefore, a single calibration point, preferably around the concentration of concern, is normally all that is required to plot peak height response in ppm as a function of compound concentration. Data for other compounds on the same column may also be plotted along with their associated retention times, percent relative response in the total organic Survey Mode, Threshold Limit Value (TLV), etc. It is recommended that copies of the actual chromatograms be kept with the charts for observing the peak shapes, peak interferences, etc. It should be noted that a chromatogram can be utilized like a fingerprint for compound identification or peak height and shape comparison. Transparent overlays are an aid in chromatogram analysis.

When temperature variations are anticipated, data should be taken at several points and recorded on the chart as a new curve or as a relative change as a function of temperature as illustrated in Figure 10.

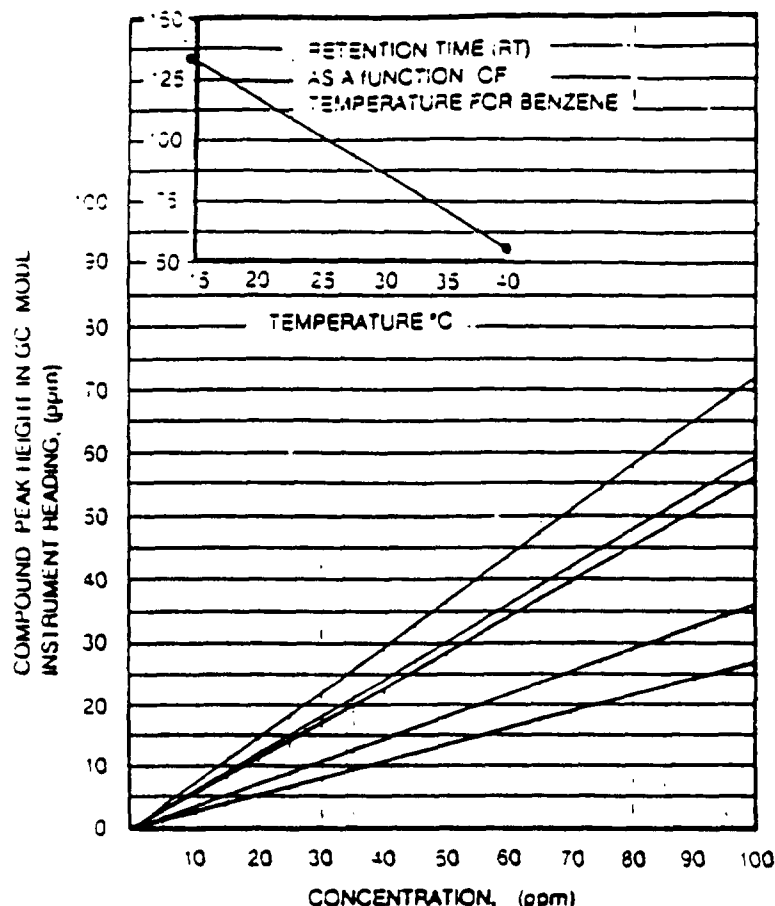
Preparing and using calibration chart is very straightforward. As an example, once the elution sequence of a group of compounds is determined, a mixture of 100 ppm of each can be prepared and run on the GC for chart data. The retention time and peak height of each compound can be read directly from chromatogram and the data put on the chart. If temperature data is to be taken, additional chromatograms may be run with the same sample, and the RT and peak height as a function of temperature.

When complex mixtures such as gasoline are analyzed, it may be desirable to keep the record of the backflush peak for future reference and peak area comparison. It is also recommended that the total organic vapor concentration reading on the OVA be recorded for each calibration sample used. This reading is used for arriving at relative response numbers and as a check on sample preparation precision.

### Routine Maintenance

#### Column Maintenance

Any column can be contaminated with compounds having long retention times. This will result in high background readings. This condition can be checked by installing a new column or a blank column (tubing only). If this reduces the background reading, the contaminated column should be baked at 100°C (212°F) for three to four hours in a drying oven while passing nitrogen through the column. Higher temperatures may permanently damage the column packing.



COLUMN G-48, CHROMATOGRAPH QV-129  
TEMPERATURE 25°C, CARRIER FLOW 12 mL/s  
INJECTION: VOLUME 2.5 mL TYPE valve

COMPOUND	PEAK HEIGHT	R.R. (%)	RT (sec)	TLV (ppm)
	G.C. MODE	SURVEY MODE		
HEPTANE	72	75	471	400
PENTANE	59	65	90	1000
HEXANE	56	75	198	100
BENZENE	36	150	291	1
TOLUENE	27	110	762	200

#### NOTE

CONCENTRATION USED FOR TEST IS  
100 ppm OR AS INDICATED.

Figure 10. Calibration Chart

When installing any column, avoid touching the ends, as this may cause contamination. Also, ensure that the fittings are tight to avoid hydrogen leakage.

**IMPORTANT:** The following simple test may be run to determine whether the GC column is contaminated. While in a clean ambient air background and clean charcoal in scrubber, place the Sample Inject Valve in the "IN" (GC Mode) position. Observe the background reading on the meter or recorder. After one to two minutes, change the position of the Backflush Valve and again observe the background reading. If the background reading went down and then started to increase in one to two minutes, the column is probably contaminated and needs to be cleaned. Note that if hydrogen flows into one end of the column for a period of time, the contamination is pushed into the column.

Then when the hydrogen flow is reversed, the exhaust end of the column will be clean until the contamination is again pushed through. Remember that to clean a column, the purge gas must be run through the column in one direction until all contamination is removed.

#### NOTE

Contaminated columns can be avoided by backflushing the column after every analysis.

## Charcoal Scrubber Assembly Maintenance

After repeated use, the Charcoal Scrubber Assembly will become saturated. Periodically, the operator should check the effectiveness of the activated charcoal.

This can easily be done by operating unit with Sample Injection Valve "IN" and passing probe near a concentrated sample of compound (other than methane or ethane) being analyzed. The readout should remain nearly steady (should not rise more than 0 to 2 parts per million (ppm)). If rise is more than 2 ppm, replace old charcoal with new activated charcoal. Care should be taken to completely fill tube to prevent a path for sample to bypass charcoal. The life of the charcoal depends on time (length) of exposure and concentration level during that exposure. When changing charcoal, be sure that any fine charcoal dust is removed from the assembly by blowing prepurified nitrogen through scrubber.

Another test of the charcoal filter is to note background reading with Sample Inject Valve "OUT" and then note reading with valve "IN". The level should never be higher when the valve is in "IN" position and charcoal filter is in air line. If the reading with the valve in the "IN" position is higher, the charcoal filter is probably contaminated and acting like a contamination emitter.



## Troubleshooting

Table 2 presents recommended field trouble shooting procedures which are associated with the GC system. These procedures are in addition to those found in the basic OVA section of the manual.

Table 2. Summary of Troubleshooting Procedure OVA 128 with the GC Option

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
1. Low sample flow rate on flow indicator.	<p>a. Check Teflon tubing on valve assembly for kinks, etc.</p> <p>b. Check flow rate with valve in down position.</p>	<p>Straighten or replace Teflon tubing. P/M 012942 (12 inches required).</p> <p>Check for over restriction of charcoal filter.</p>
2. Hydrogen flame will not light.	<p>a. Check column connections on top of unit to make sure they are tight.</p> <p>b. Check column for sharp bends or kinks. (Hydrogen flows through this column at all times and a sharp bend will compact packing too tightly for proper hydrogen flow.)</p> <p>c. Check charcoal filter fittings to make sure they are tight (GC Mode only).</p> <p>d. Check hydrogen flow rate from column.</p> <p>e. Check that the Inject and Backflush Valves are both completely in or out. A partially activated valve will block the hydrogen and air flow paths.</p> <p>f. If a new column was installed prior to problem identification, check for proper hydrogen flow rate through the column (should be approximately 12 cm/min).</p>	<p>Tighten fittings.</p> <p>Replace column.</p> <p>Tighten fittings.</p> <p>Adjust hydrogen pressure to obtain 12 cm<sup>3</sup>/min flow rate.</p> <p>Ensure both valves are either completely in or out.</p> <p>Increase hydrogen pressure to obtain proper hydrogen flow rate or if column is excessively restrictive, replace or repack the column.</p>
3. Ambient background reading in clean environment is too high.	<p>a. Check for contamination in charcoal filter assembly. This can be detected if ambient reading increases when going in to the chromatographic mode.</p> <p>b. Check for contamination in column.</p> <p>c. Check for contamination in column valve assembly. Replace Quad Rings if torn or nicked (P/M 510496-1, package of 10).</p>	<p>Replace activated charcoal in charcoal filter assembly.</p> <p>Replace or clean column.</p> <p>Remove valve stems and wipe with clean lint-free cloth. Heat valve assembly during operation to vaporize and remove contaminants.</p>
4. Flame-out when operating either valve.	<p>a. Ensure valves are being operated with a quick, positive motion.</p> <p>b. Either hydrogen or air may be leaking around one or more of the valve quad rings. Assess by test and quad ring inspection.</p> <p>c. Damaged or worn quad rings causing leak.</p>	<p>Operate valve with a positive motion.</p> <p>Remove stems and lightly coat with silicone grease. (Dow Corning III odorless only, silicone grease) only on contact surface of quad ring. Wipe off excess (do not remove quad rings)</p> <p>Replace quad rings and grease as above.</p>

Table 2. (Cont.)

PROBLEM	TROUBLESHOOTING PROCEDURE	REMEDY
5. Excessive peak tailing.	<p>a. Change or clean GC column; see if problem disappears.</p> <p>b. Inspect GC valves and valve stems for excessive silicone grease or contamination.</p>	<p>Ensure columns are clean prior to use. If one of the same type of column tails are worse than others, repack the column or discard.</p> <p>Excessive lubricant or foreign matter in the valve assembly can cause excessive tailing. Clean valve assemblies and lightly relubricate quad rings as required. Lubricant should be put only on the outside contact surface of the quad ring. Do not get grease into the quad ring grooves.</p>

## ACCESSORIES

### Recorder Accessory

A portable Strip Chart Recorder is available for use with the OVA (reference Figure 12). The recorder is powered from the OVA battery pack and the output can be scaled to match the OVA readout meter, thereby providing a permanent record for subsequent analysis or reference. P/N 510445-4 is FM certified intrinsically safe. P/N 510445-6 is BASEEFA certified.

The recorder can be used with the OVA to provide a long term monitoring profile of total hydrocarbon or can be used with the Gas Chromatograph Option to provide a chromatogram.

### Recorder Features

The recorder prints dry (no ink) on pressure sensitive chart paper. The recorder is equipped with two gain ranges and an electronic zero adjustment. The HIGH gain position is normally used to provide a means of scale expansion.

### Recorder Controls and Connections

Described below are the functions of recorder controls and connectors.

1. HIGH-LOW Switch - This switch, located on right hand side of the recorder, provides two ranges. The LOW range is set for the same full scale reading as the OVA readout meter. The HIGH range can be set to five and increased sensitivity to the recorder without affecting the OVA calibration.
2. ZERO ADJUST Knob - This potentiometer, located on right hand side of recorder, permits "nulling" of the background reading on the recorder without affecting the calibration of the OVA display on the OVA readout. In full clockwise position, the recorder will display the same reading as the OVA meter. Counterclockwise rotation will reduce reading on recorder.
3. POWER CONNECTOR - This 126 series 5-pin connector provides power and signal to the recorder, as follows:

PIN	FUNCTION
B	Input Signal
E	pos. 12 V dc input
H	Ground

## Recorder Calibration

Electronic and mechanical adjustments, other than the operational adjustments on the side panel, are provided to calibrate and align the recorder. (See Figure 11.)

### MECHANICAL ZERO ADJUSTMENT --

1. Snap out the front panel nameplate using a small blade screwdriver in the left hand slot for access to mechanical zero adjust screw. Place HIGH-LOW Switch in OFF position.
2. Unscrew knurled fastener at top of front panel to open recorder. Pull down plastic chassis latch on right side to release sticker bar tension on paper and adjust mechanical zero as required. Replace nameplate and chassis latch, and resecure front panel.

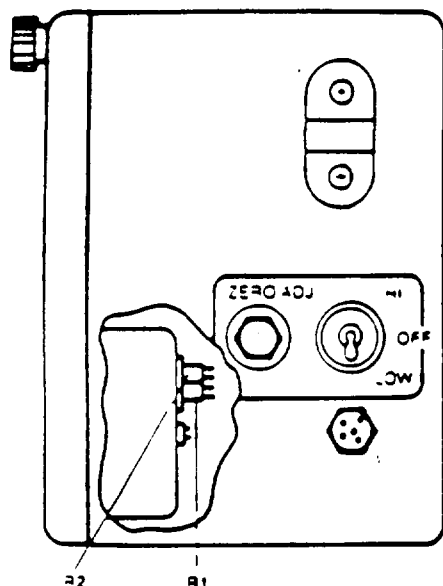


Figure 11.

Recorder Controls and Adjustments

GAIN ADJUSTMENT -- Separate adjustments are provided for the HIGH and LOW ranges on the recorder. (Refer to Figure 11 for location.)

1. Connect recorder to OVA and adjust OVA for full scale reading on readout (about 5 V dc).
2. Loosen knurled fastener on upper left of the front panel and pull front panel down.
3. Place HIGH-LOW Switch in LOW and adjust R1 until recorder prints full scale.
4. Place HIGH-LOW Switch in HIGH and adjust OVA to read the desired full scale with front panel CALIBRATE ADJUST knob, typically half scale on the readout. Adjust R2 until recorder reads full scale.

### NOTE

Full scale adjustment of the recorder for 1/2 scale on the OVA gives a gain increase of two (2) in the height of the peak on the chromatograms. This is the factory set point for the HIGH gain range; however, other points can be set as desired, with a gain of three being the maximum obtainable without amplifier loading.

## Recorder Maintenance and Routine Operations

Refer to the manufacturer's (Gulton) manual on the recorder which is enclosed with each recorder when shipped.

## Changing Recorder Chart Speeds

The recorder is equipped with a 16 RPM motor which gives a writing speed of four (4) strikes per second. The chart advance speed is determined by the gear train assembly number used.

To change the paper speed, open the recorder, remove gear box spring (on left side), move gear box in direction of arrow on its case, and lift out from top. Do not force out from bottom. Insert new gear, bottom first, and slide into position against arrow direction. Replace gear box spring.

## Activated Charcoal Filter Adapter (Figure 12)

The Activated Charcoal Filter Adapter (P/M S10095-1) is an accessory which can be installed on the OVA Readout Assembly, or attached at the end of the telescoping probe. The filter is typically filled with activated charcoal which acts as an absorbent and effectively filters out organic vapors other than methane or ethane.

A screw cap on the probe end is removed for refilling the filter with activated charcoal or other filtering media.

Applications of the filter include:

1. Obtaining a clean air sample for zero baseline check and adjustments.
2. Running "blank" chromatograms to assess instrument contamination.
3. Rapid screening of methane and non-methane organic vapors.
4. Selective screening for natural gas surveys.
5. As a moisture filter when filled with a desiccant such as silica gel.

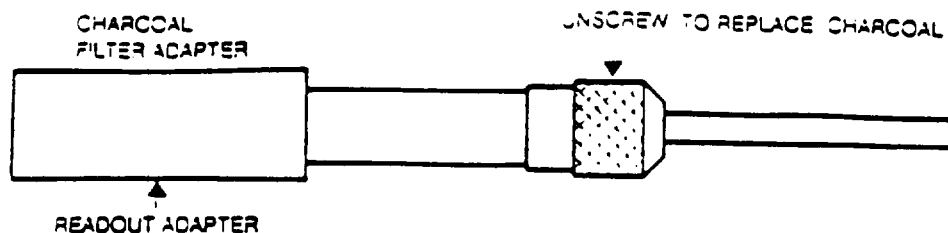


Figure 12. Activated Charcoal Filter Adapter

A press fit adapter on the back of the filter assembly is removed when installing the unit on the telescoping probe. When replacing the cap end after refilling, one wrap of 1/4 inch Teflon tape should be used to seal the threads.

The life of the filter will depend on the time in use and the concentrations of the compounds being filtered. Under typical industrial air monitoring conditions, filter will last for many days of continuous sampling.

external tubing to the input fitting of the OVA sidepack. Dilution of the air being monitored is accomplished by stream splitting through the use of a needle valve on the sample input. An activated charcoal scrubber is inserted in the main air supply line to the OVA and scrubs the air of organic vapors. It also creates a slight vacuum at its output side of the scrubber and the vacuum at this point draws the sample air through the needle valve where it mixes with the main air supply going to the OVA detector.

### Sample Dilutor Accessory (Figure 13)

An adjustable sample dilutor assembly, P/N CR010MR is an accessory. The dilutor is supplied with a 10:1 dilutor orifice (P/N 511770-1) as standard. Orifices for 25:1, P/N 511770-2, and 50:1, P/N 511770-3, dilution are also available.

A fine metering dilution valve provides a means of monitoring sampling vapor levels above the lower explosive level (LEL) and in oxygen deficient atmospheres. These conditions can occur in normal leak or source survey as the operator gets close to the leak or vapor source, or in monitoring various manufacturing or material handling processes. Approximately 14% oxygen is required to sustain operation of the FID in the OVA.

In operation, the dilutor is attached to the end of the close area sampler or connected by

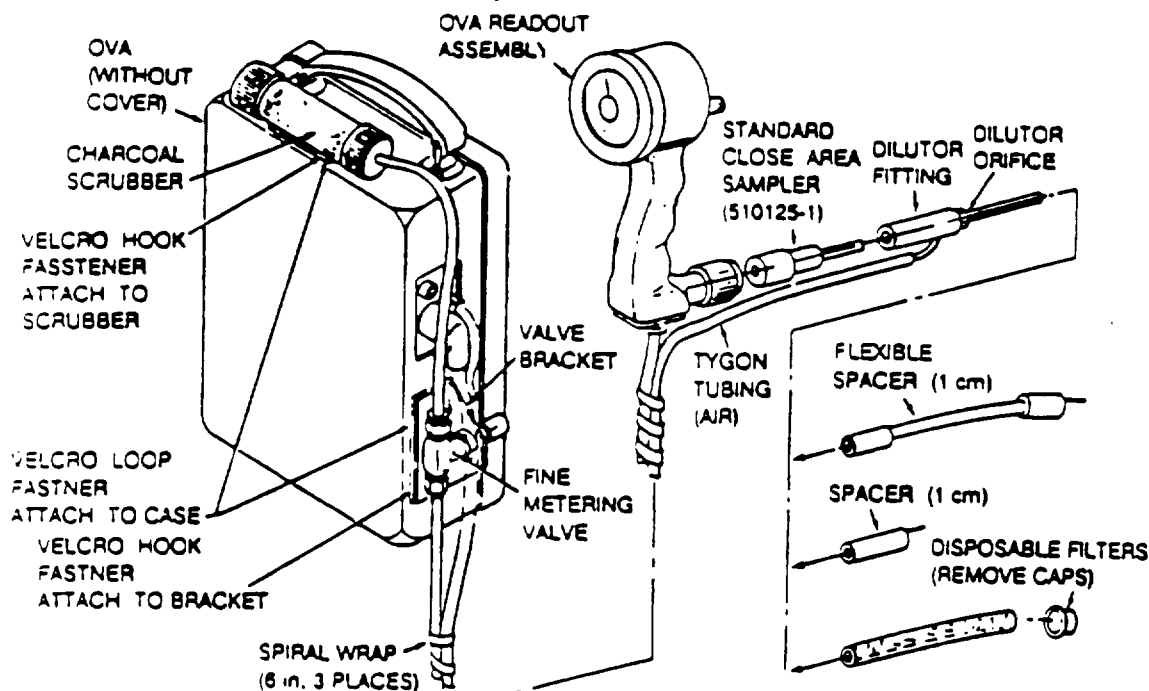


Figure 13. OVA Sample Dilutor

## Setting Dilution Rate of Dilutor Accessory

Prepare a sample in a bag at a high level, typically 1,000 to 5,000 ppm. Any suitable gas can be used, such as methane or butane; however, a compound similar to those to be measured provides greater accuracy. The actual concentration of the gas does not have to be known, since the dilution rate is simply a relative level.

Obtain an OVA reading on the vapor orifice sample with the dilution removed. Then install the orifice, and turn the valve until fine metering the meter reading corresponds to the original reading divided by the dilution factor desired.

It should be noted that when the dilution valve is used for natural gas leak survey and pin-pointing, the charcoal filter will not remove the methane from the dilution air supply. Care should be taken that natural gas is not allowed to enter the main air inlet.

## OVA Septum Adapter Accessory

A Septum Adapter, P/N 510645-1, is available for direct on-line sample injection to the GC column inlet. The Septum Adapter mounts directly on the OVA front panel and sample injections from 0.025 to 2.5 cm may be made using a gas tight syringe.

This provides a range of sensitivity of approximately 10% to 1000% of the OVA standard valve, which has a standard sample loop volume of approximately 0.25 cm. Syringe injection can cause flame-out, however, the OVA may be re-ignited after the injection is made. The air

in the sample must elute from the column before reignition. The time for the air peak to elute is a function of the column length and the volume of the sample injected. For example, a 1 cm sample into a 12-inch column will require approximately 5 seconds; and, a 2.5 cm sample into a 48-inch column will require approximately 20 seconds.

The Septum Adapter also provides a means whereby samples from oxygen deficient atmospheres or process stream can be injected directly into the chromatograph. Headspace analysis may also be accomplished using the Septum Adapter and a syringe.

When the Septum Adapter is installed on the OVA, the normal GC sample valve may still be used alternatively with the syringe injection. In addition to variable sample size and sensitivity, syringe injections will normally provide greater symmetry and reduce tailing of chromatogram peaks as compared with the standard valve injection. Additional information on the Septum Adapter can be found in Foxboro Technical Information document TI 612-115.

## OVA Portable Isothermal Pack (PIP) Accessory

A column can separate an exceptionally wide variety of components if the separations are made at different temperature ranges. In addition, peak heights and retention times can vary with column temperature. The PIP option (Figure 14) was developed to control column temperature, without affecting the analyzer's intrinsic safety specifications and without compromising the analyzer's portability or battery life.

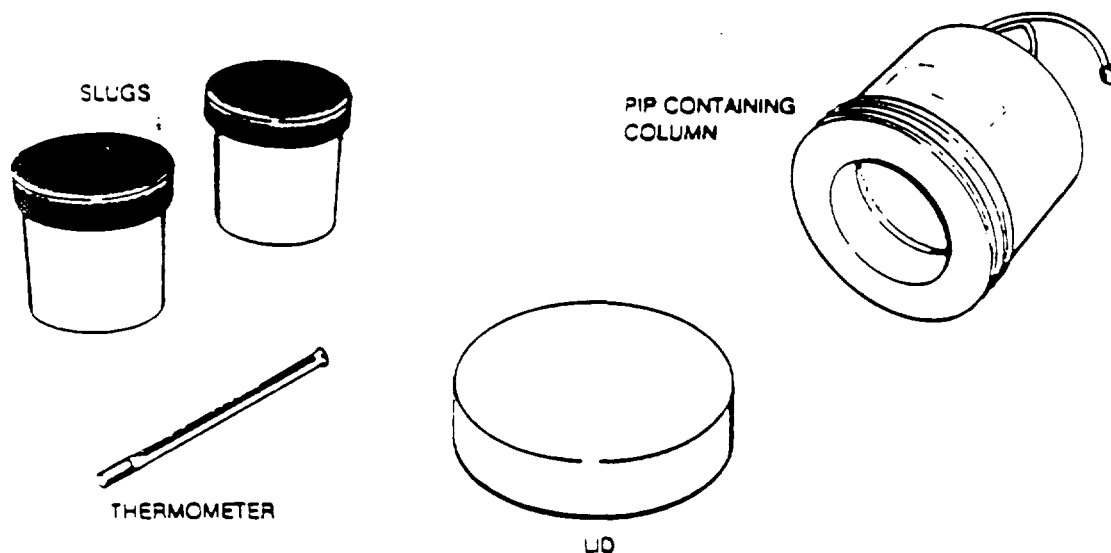


Figure 14. Portable Isothermal Pack

### PIP Components and Spare Parts

511800-1	PIP Kit
511805-1	PIP Assembly (specify column length and packing material)
511810-1	40°C Slug (phase-change material)
511830-1	Seeder for 40°C Slug
511815-1	Aluminum Slug
511820-1	Empty Slugs (package of six)
511825-1	Insulating Cover
511826-1	Thermometer

PIP columns can be prepared with any standard column packing material. A temperature control slug is inserted into the PIP slug cavity which has exterior foam insulation. For field operation in extreme ambient temperatures, an additional sheepskin jacket can be installed. The period of temperature control depends upon the temperature difference between ambient and the slug. For a 0°C ice pack and ambient temperature of 27°C, a control period of approximately ten hours is typical. Additional information on the PIP system will be found in Foxboro Technical document TI 611-105.

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TABLE 1-1  
REFERENCE DATA

a) DESCRIPTION

Trace Gas Analyzer

HNU Systems, Inc.  
Photoionization  
Analyzer Model HW 101

b) FUNCTIONAL CHARACTERISTICS (see NOTE)

Detection Range *	0.1 to 2000 ppm (parts per million by volume)
Minimum Detection Level *	0.1 ppm
Maximum Sensitivity *	0 to 20 ppm FSD (Full Scale Deflection)
Repeatability *	plus or minus 1% of FSD
Linear Range *	0.1 to 400 ppm
Useful Range *	0.1 to 2000 ppm
Response Time	Less than 5 seconds to 90% of FSD
Ambient Humidity	up to 90% RH
Operating Temperature Ambient	0 to 40 degrees C.
Operating Time on Battery	Approximately 10 hours
Battery Recharge Time after normal use	Approximately 6 hours
Battery Charger Power	120V AC, single phase, 50-60 cycle, 1.5 Amps

NOTE: Items marked with asterisk valid when span  
control set at 9.8 and measuring benzene.  
Values will vary for other compounds and conditions.



TABLE 1-2  
EQUIPMENT SUPPLIED

Quan.	Name	Overall Dims CM (inches)	Weight Kg. (lbs)	Volume cm <sup>3</sup> (cu ft.)
1	Photoionization Analyzer (stored condition)	21W x 13D x 24H (8 1/4 x 5 3/16 x 9 1/2)	4.7 (10.28)	6552 (0.23)
	Probe Assembly	6.0 Diam x 34.3L (2 3/8 x 13 1/2)	1.2 (2.7)	636 (0.023)
	Readout Assembly	21W x 13D x 16.5H (8 1/4 x 5 3/16 x 6 1/2)	3.4 (7.5)	4504 (0.16)
1	Battery Charger with cord	7.3W x 8.0D x 10.2L (2 7/8 x 3 1/8 x 4)	0.4 (0.9)	596 (0.021)

TABLE 1-3

## EQUIPMENT REQUIRED, NOT SUPPLIED

Test Equipment Category (name)	Representative Test Eq. Model No.	Equipment Test Parameters	Application
Container/ Calib. Gas	HNU Systems Inc. cylinder, No. 101-350	Lightweight disposable steel cylinder containing 30 liters (3.6 cubic feet) at 300 lb/in <sup>2</sup> and 70 °F. Contents to be 100 ppm of isobutylene in zero air +/- 10% -- rated concentration listed on cylinder.	Calibration
Regulator	HNU Systems Inc. regulator, NO. 101-351	Single stage regulator, flow preset at factory, 200-300 cc per minute, gage indicates pressure of tank contents	Calibration
Voltmeter	Multimeter, digital type	0 - 1500 V DC	Maintenance
Tubing	Latex	0.187 ID and 0.250 OD	Calibration
Compound, lamp cleaning	HNU part No. PA 101534-A1		Maintenance

## CHAPTER 2

### OPERATION

#### 2-1 INTRODUCTION

The Photoionization analyzer is a portable instrument used to detect the concentration of a variety of trace gases in an atmosphere. The principal elements consist of a probe and a readout assembly. Associated elements consist of a battery charger and carrying straps.

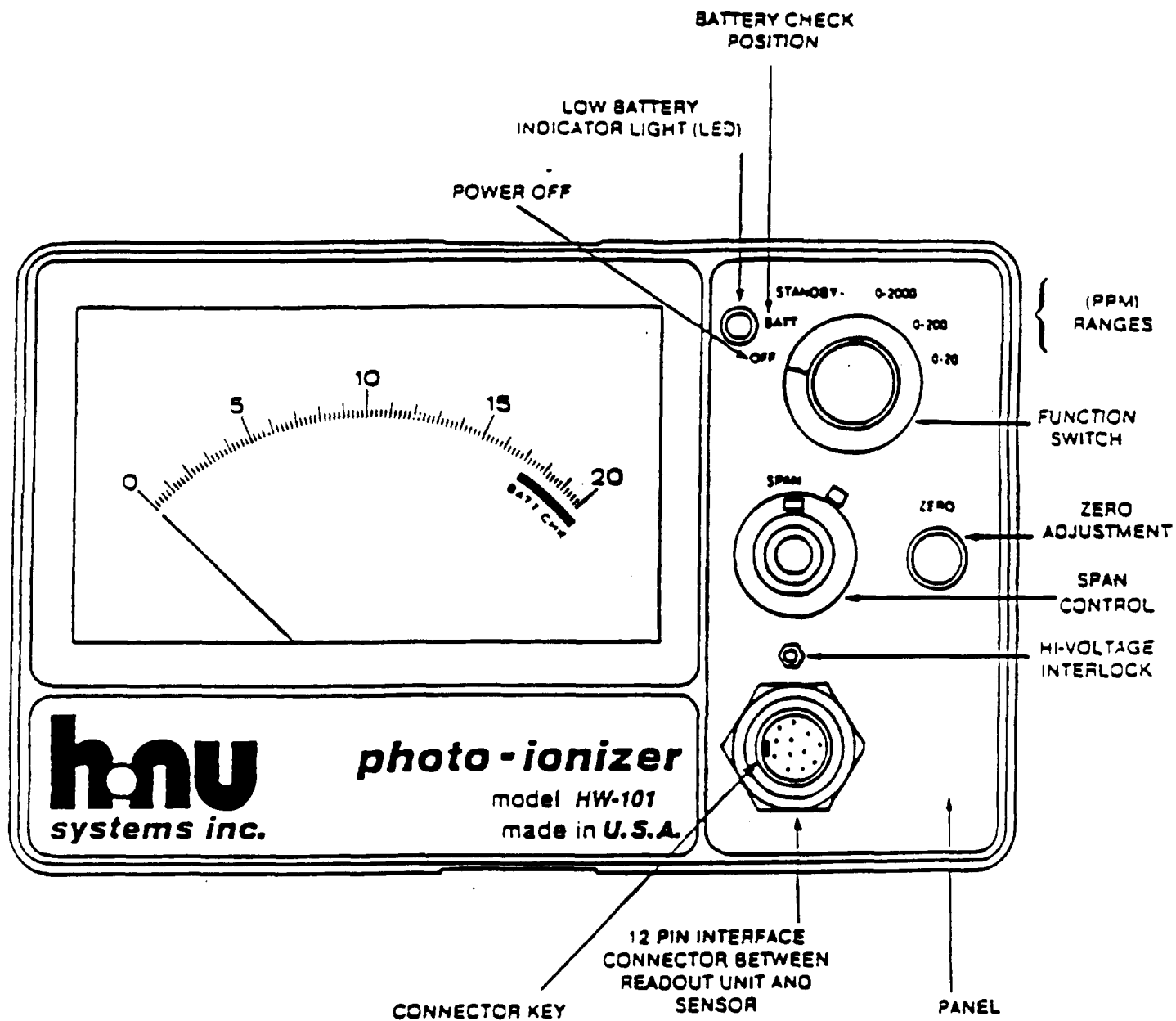
#### 2-2 CONTROLS AND INDICATORS

The controls and indicators are located on the panel of the readout assembly (see Figure 2-1) and are listed and described in Tables 2-1 and 2-2.

#### 2-3 OPERATING PROCEDURES

The following are the procedures to be used in operating the analyzer:

- a. Unclamp the cover from the main readout assembly.
- b. Connect the probe cable to the 12 pin keyed connector on the readout assembly panel.
- c. Screw the filter nozzle securely into the probe end cap. NOTE: This must be in place for proper operation.
- d. Set the span control as specified by the initial factory calibration or by subsequent calibrations (see Section 4-4).



**FIGURE 2-1**  
**CONTROLS AND INDICATORS**

- e. Turn the function switch to the BATT (battery check) position. The needle on the meter will go to the green zone if the battery is fully charged. If the needle is below the green zone, the Low Battery Indicator comes on, the battery must be recharged before the analyzer is to be used.
- f. Turn the function switch to the STANDBY position. Turn the zero adjustment until the meter needle is at zero.
- g. Calibrate the instrument as necessary (see para. 4.4).
- h. Turn the function switch to the appropriate operating position. Start with the 0-2000 position and then switch to the more sensitive ranges as required to give the best resolution and upscale display.

The analyzer is now operational.

- i. Hold the probe so that the nozzle is at the point where the measurement is to be made.

The instrument measures the concentration by drawing the gas in the end of the nozzle, passing it through an ionization chamber, and discharging the gas at the end of the probe opposite from the tip.

#### CAUTION

-----  
The probe will draw samples from low pressure areas, i.e., from ductwork, or from any distance, and will draw in water.

**DO NOT IMMERSE NOZZLE IN LIQUIDS!!**  
**DO NOT IMMERSE NOZZLE IN DIRT, AS FRITTED FILTER WILL CLOG!**

WARNING

-----  
A high reading should be cause for protective action since the instrument measures gases in the vicinity of the operator.

Take the reading or readings as desired being aware that air currents or drafts in the vicinity of the probe tip may cause fluctuations, and a stable reading may not be possible under these conditions. Change the function switch scale ranges as required.

Samples may be drawn from some distance as the pump is somewhat powerful.

WARNING

-----  
Do not dead head the pump as the vacuum in the ion chamber will change affecting an accurate reading.

- j. When not conducting measurements and when analyzer is to be kept in readiness state, turn function switch to OFF position.
- k. Check battery condition as required by turning the function switch to BATT position. Normal operating time between recharging is 8 to 10 hours. If the Low Battery Indicator comes on, turn analyzer off and recharge.

CAUTION

-----  
Use only in an emergency with a low battery when on battery charge. See para. 4.2.

- l. After completion of each operating period turn function switch to OFF position, and recharge battery.
- m. When not operating, leave analyzer in assembled condition, and connected to battery charger.
- n. When transporting, disassemble probe readout assembly. Protect nozzle from dust and dirt.

## 2-4 SPECIAL PRECAUTIONS

### 2-4.1 ELECTROMAGNETIC RADIATION

The analyzer is well protected against interference from electromagnetic radiation so no errors normally occur from such sources such as large electric motors, transformers, switching stations, electromagnets, etc. In an extreme case very close to a highly radiating source, the possibility of such an effect can be determined and corrected by the following procedure. Zero the analyzer in an electrically quiet area with the function switch in the STANDBY position. Then move the analyzer to the questionable area with the switch still in the STANDBY position. If AC pick up is occurring, the meter will indicate the magnitude of the error. The measurement in the operating position can then be compensated by subtracting this value.

TABLE 2-1

## CONTROLS

Name	Position	Function
Function Switch		Controls the operation of the analyzer
	OFF	All operations OFF
	BATT (Battery check)	Check the condition of the battery. If the needle on the meter is in the green arc, the battery is charged. If the needle is not in the green arc the battery should be recharged. Can be done in any position, best in OFF, see directions on charger.
	STANDBY	All electronics ON, ultraviolet (UV) light source OFF. This position conserves power and extends battery life. This position is used to set the analyzer zero position. (i.e. no UV light, no signal.)
	0-2000	Sets range of meter at 0-2000 ppm.
	0-200	Sets range of meter at 0-200 ppm.
	0-20	Sets range of meter at 0-20 ppm.
Probe LED Bar Graph Display		Provides relative indication of meter reading (concentration). Each LED of the Bar-graph Display represents 10% of the full scale setting of the range switch.
ZERO		With the function switch in STANDBY position, this control is used to adjust the analyzer to read zero.



Name	Position	Function
SPAN		<p>This control is used to set the sensitivity of the amplifier to make the meter give direct readings of the trace gas concentrations in ppm.</p> <p>This control is a vernier control. The whole number of the setting appears in the window of the control, decimal parts appear on the dial. A lock on the control secures it in a specific setting.</p>
HI-VOLTAGE INTERLOCK	---	This is a normally open push button switch.
	Open	<p>Switch is open when cable not connected, causing high voltage for the UV lamp to be disconnected from the 12 pin connector for the probe as a safety precaution.</p>
	Closed	<p>Switch is closed when the probe cable is connected to the readout panel. This connects high voltage to the socket. This switch is automatically closed when the cable is attached by the pressure of the cable connector on the switch push button. This switch may also be closed manually during maintenance checks of the readout assembly without the probe cable attached.</p>

NOTE: See Figure 2-1 for locations

TABLE 2-2  
INDICATORS/CONNECTORS

Name	Function
Low Battery indicator (LED)	Illuminates after approximately 10 hours.
Probe Connector	Do not attempt to take readings when this light is on.  12 pin connector for cable between the readout assembly and the probe.
Meter/ Probe L.E.D.	Indicates concentration of measured gas.

NOTE: See Figure 2-1 for location.

## CHAPTER 3

### FUNCTIONAL DESCRIPTION

#### 3-1 PRINCIPLE OF OPERATION

The analyzer measures the concentration of trace gases present in the atmosphere by using the principle of photoionization. Photoionization occurs when an atom or molecule absorbs light of sufficient energy to cause an electron to leave and create a positive ion. This will occur when the ionization potential of the molecule is less than the energy of the photon. The ionization potential of a molecule is that energy in electron volts (eV) required to free an electron. In the HW 101, the source of photons is an ultraviolet lamp with an energy of 10.2 eV.

The detection process in this analyzer is shown in Fig. 3-1. Sample gases enter through the nozzle into the ion chamber.

The ultraviolet lamp generates photons with an energy of 10.2 eV and these enter the ion chamber. Ionization occurs for those molecules having ionization potentials less than 10.2 eV.

A positive biased electrode causes these positive ions to travel to a collector in the chamber. Here ions create a current proportional to concentration at the collector which is then amplified and the signal displayed on the meter.

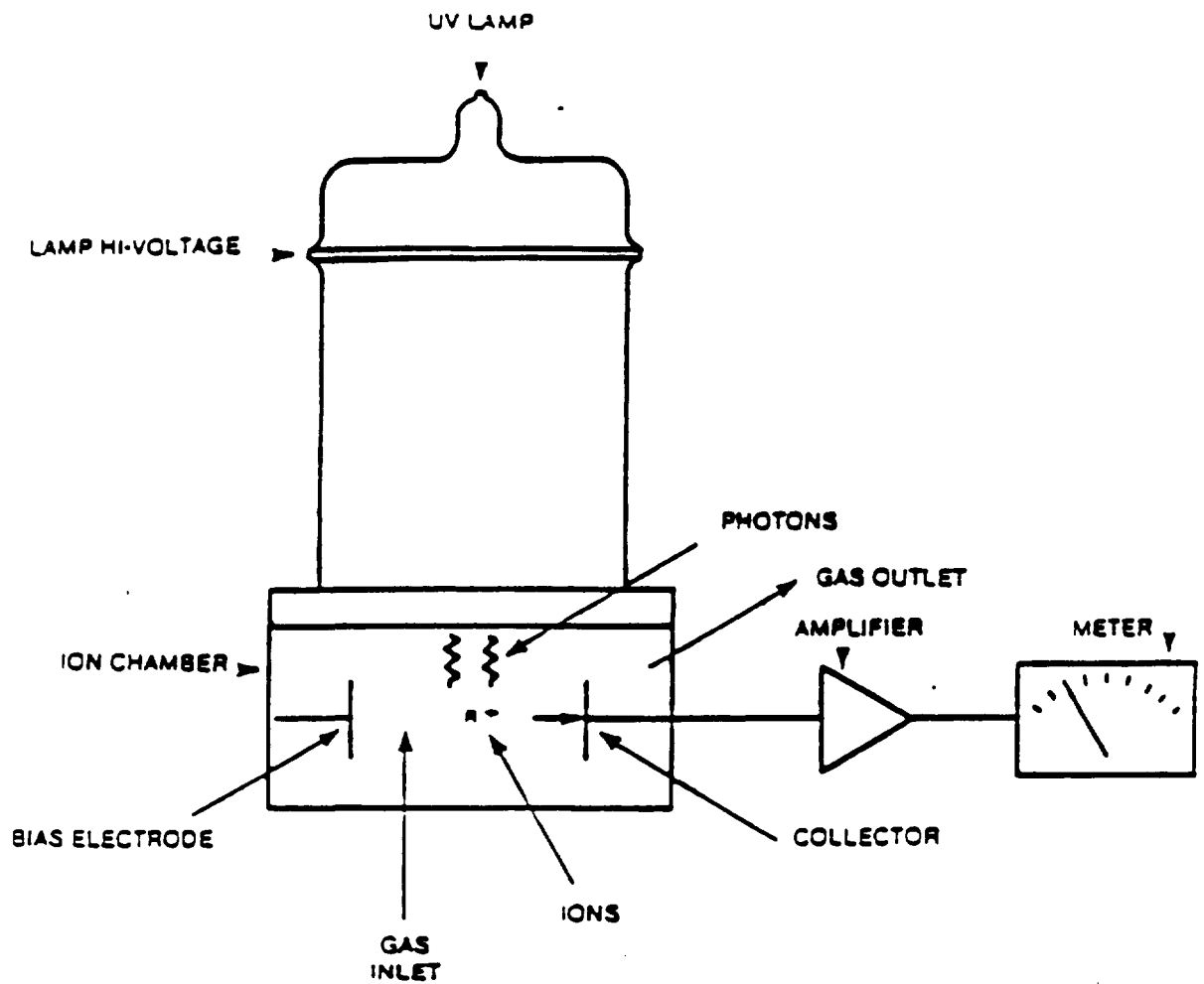
The amount of ionization occurring, and thus the input signal to the amplifier, is proportional to the amount of trace gas present in the ion chamber and to the ionization sensitivity of that gas.

Gases that will be ionized are those with ionization potentials of 10.2 eV or less. Typical gases that will be ionized and their potentials are listed in Table 3-1. These gases will thus be detected and measured with this analyzer.

The ion chamber is kept at reduced pressure to minimize effects of humidity and other gases:

Gases having ionization potentials higher than approximately 10.2 eV will not be ionized by this analyzer. Examples of these and their potentials are listed in Table 3-2. As can be seen from the table the ionization potential of the major components of air, i.e., oxygen, nitrogen, carbon dioxide, and of methane and freons, range from about 12.0 eV to about 15.6 eV and will thus not be ionized by photons from the 10.2 eV lamp.

When the analyzer is used to measure a mixture of gases, such as hydrocarbons in air, a calibration gas is selected to approximate the average response of the components to be measured. In this case, isobutylene is the compound whose response best approximates these hydrocarbons.



**FIGURE 3-1  
DETECTION PROCESS**

TABLE 3-1

## TYPICAL GASES THAT WILL BE IONIZED BY THE ANALYZER

Gas	Ionization Potential (eV)
Xylene	8.56
Toluene	8.82
Cyclohexanone	9.14
Benzene	9.25
Isobutylene	9.44
Trichloroethylene	9.45
Methyl ethyl ketone	9.53
Tetrahydrofuran	9.54
Acetone	9.69
Vinyl chloride	10.00
Ammonia	10.15
Isopropanol	10.17
Hexane	10.18
Ethanol	10.48

TABLE 3-2

## TYPICAL GASES THAT WILL NOT BE IONIZED BY THE ANALYZER

Gas	Ionization Potential (eV)
Methanol	10.85
Nitromethane	11.08
Methyl chloride	11.28
Chlorine (Cl <sub>2</sub> )	11.48
Methyl chloroform	11.5
Freon 11	11.77
Freon 113	11.78
Genetron (101)	11.98
Freon 114	approx. 12
Oxygen (O <sub>2</sub> )	12.1
Acetonitrile	12.22
Freon 12	12.31
Freon 13	12.91
Methane (CH <sub>4</sub> )	12.98
Carbon dioxide (CO <sub>2</sub> )	13.79
Carbon monoxide (CO)	14.01
Hydrogen	15.426
Nitrogen (N <sub>2</sub> )	15.6

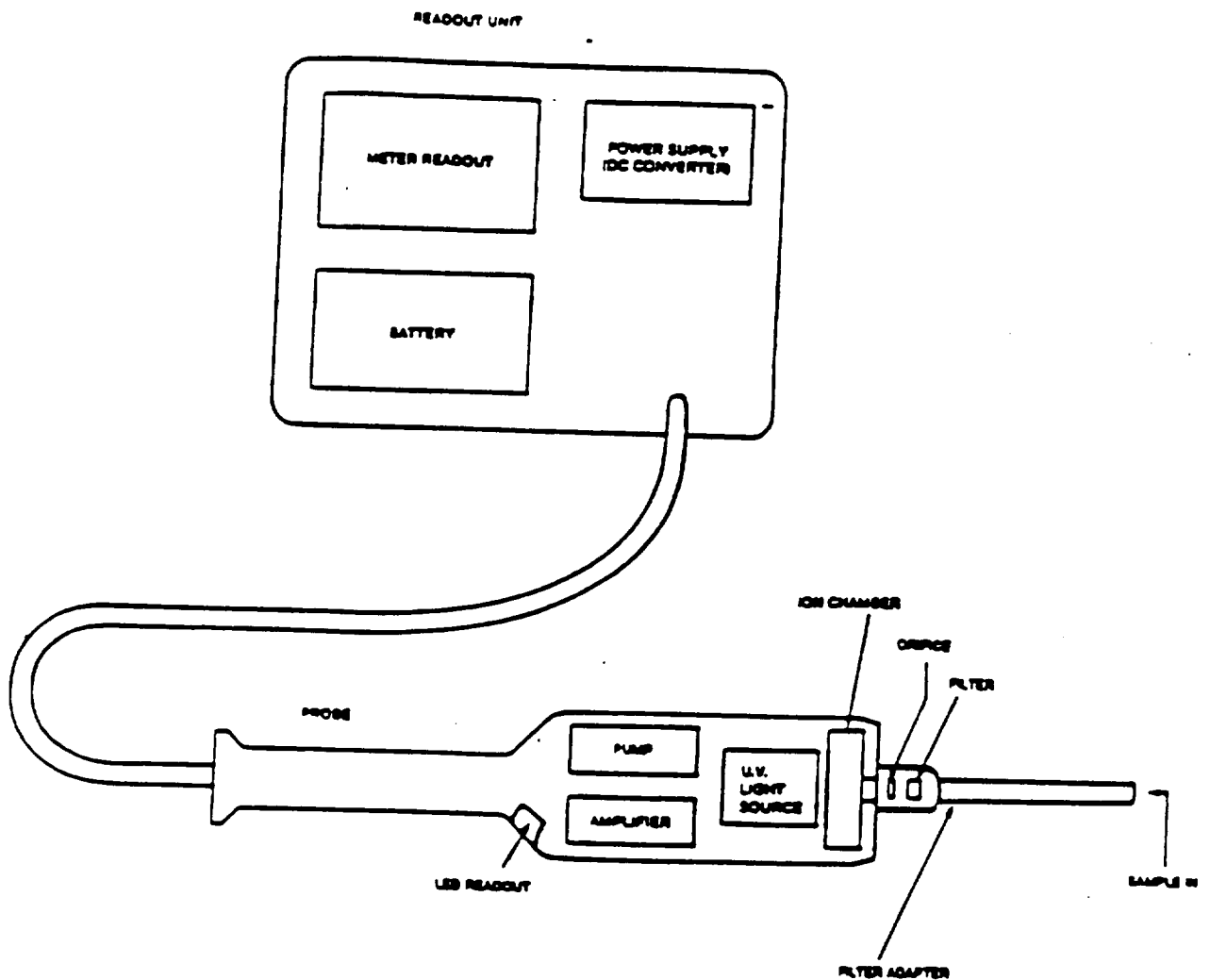
### 3-2 EQUIPMENT DESCRIPTION

The components of the analyzer are located in the probe and the readout assembly (see Fig. 3-2 and 3-3). The ion chamber, UV light source, amplifier board, pump and filter nozzle are located in the probe assembly. The battery, the power supply board, and the meter are located in the readout assembly. The probe and the readout assembly are connected by an 800 cm (32") cable.

The pump draws gas in through the filter and orifice located in the filter nozzle, through the ion chamber, and then discharges it through the hollow exhaust screw in the handle. The flow rate is approximately 175 to 275 cubic centimeters per minute. A general variation in the flow rate will not affect the measurement. A major obstruction to the flow, however, will prevent proper readings and lengthen response time, by changing the vacuum in ion chamber.

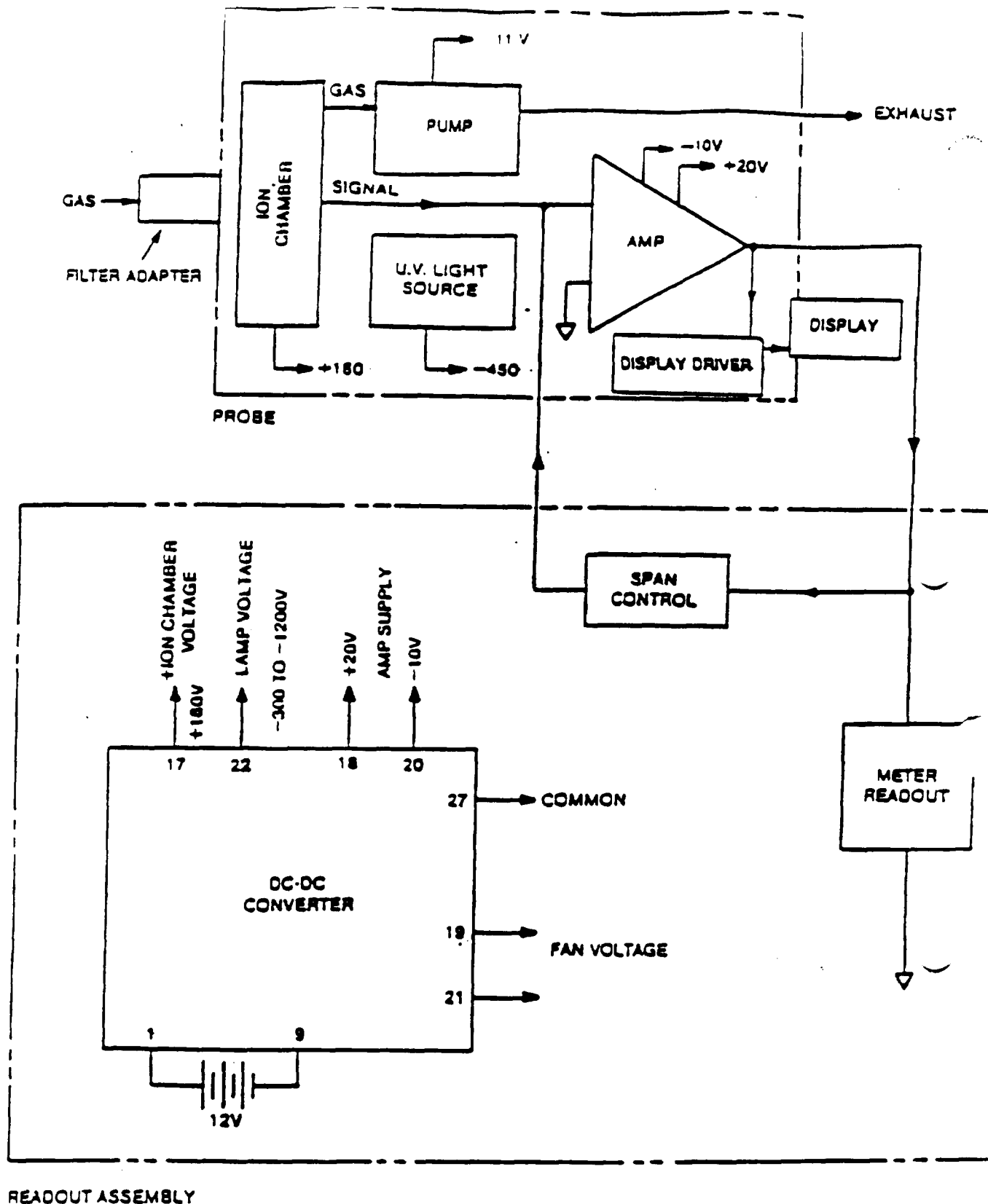
The output signal from the ion chamber goes to the amplifier and through the cable to the meter on the readout assembly.

Voltage for the light source, ion chamber, amplifier and pump is provided from a DC converter on the power supply board. The battery provides the source of power for the converter. The positive side of the battery is grounded.



**FIGURE 3-2  
BLOCK DIAGRAM  
COMPONENT LOCATION**





READOUT ASSEMBLY

NOTE: ALL VOLTAGES SHOWN ARE NOMINAL VALUES.

**FIGURE 3-3  
BLOCK DIAGRAM  
ELECTRICAL CONNECTIONS**

## CHAPTER 4

### SCHEDULED MAINTENANCE

#### 4-1 INTRODUCTION

Scheduled maintenance actions for the analyzer are those listed in Table 4-1.

#### 4-2 BATTERY CHARGE

Check the battery charge as described in paragraph 2-3g. If the battery is low as indicated by the meter reading or the warning indicator LED, it is necessary to recharge the battery.

To charge the battery, first insert the mini phone plug of the charger into the jack, J6, on the side of the bezel adjacent to the meter. Then insert the charger plug into a 120 VAC single phase, 50-60 cycle outlet. To ensure that the charger is functioning, turn the function switch, S1, to the battery check (BATT position. The meter should deflect full scale if the charger is working, leave the function switch in the OFF position.

The analyzer can be operated, however, while charging by turning the function switch to the desired position. Such usage will extend the time required to completely recharge the battery. A normal full recharge of the battery from low voltage level as indicated by the warning light takes about 6 hours.

#### 4-3 UV LAMP AND ION CHAMBER

During periods of operation of the analyzer, moisture or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. These deposits would interfere with the ionization process and cause erroneous readings. Cleaning can be accomplished as follows:

Disassemble the probe as described in Paragraph 6-2.1

#### WARNING

Turn the function switch on the control panel to the OFF position before disassembly. Otherwise, high voltage of 1200 VDC will be present.

First, clean the lamp with a mild detergent and wipe dry. Then, the ion chamber can be inspected for dust or particulate deposits. If such matter is present, the assembly can be gently swirled in ethanol or isopropanol and dried gently at 50 - 60 degrees C for approximately a half hour. No liquid must be present at reassembly as this would affect the performance.

Reassemble the probe as described in paragraph 6-2.1 and check calibration of the analyzer (see Section 4-4).

If the calibration is still not satisfactory, disassemble the probe again and clean the lamp with the special HNU cleaning compound (see Table 1-3). As this is a rigorous cleaning procedure it should be done only after the more gentle cleaning is tried as described above. Do not clean the ion chamber with this special cleaning compound. Do not clean 11.7 ev lamps with this compound, a special cleaning compound is available for 11.7 lamps.

Reassemble the probe, check to see if the lamp is on before reattaching the filter nozzle (see WARNING, Section 2-3j), and calibrate the analyzer (see Section 4-4).

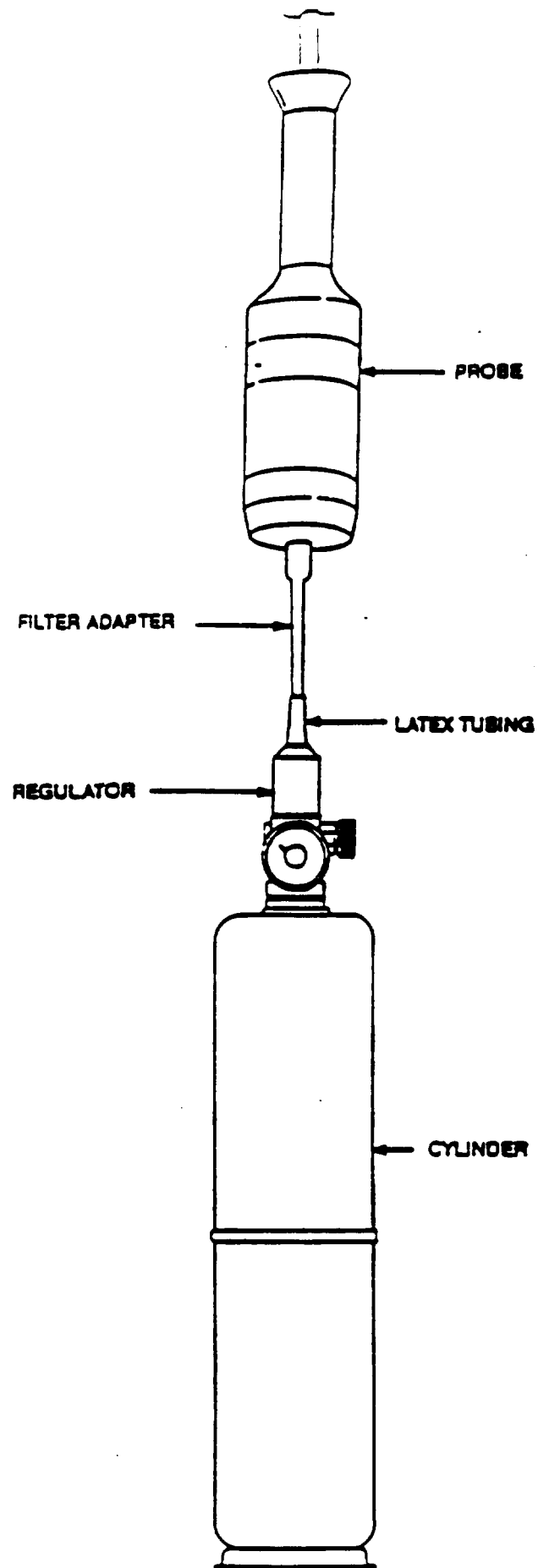
#### 4-4 CALIBRATION

The analyzer is calibrated by use of a cylinder and a regulator (see Table 1-3). The cylinder contains a calibration gas consisting of a mixture of isobutylene in zero air. Isobutylene is non-toxic and safe to use in confined areas. There are no listed exposure levels at any concentration.

The regulator sets and controls the flow rate of gas to the analyzer at a value preset at the factory.

The analyzer is connected to the output of the regulator with a short piece (butt connected) of flexible tubing (see Figure 4-1). It is important to use clean tubing since contaminated tubing will adversely affect the calibration readings.

Set the function switch on the analyzer at the desired ppm range position. The gas from the regulator will flow thru the probe. The isobutylene level in the calibration gas is specifically selected for the analyzer. The desired ppm level to be indicated on the meter is given on the cylinder label.



**FIGURE 4-1  
CALIBRATION TEST SET UP**

Adjust the span control so the meter reads the specified value. Turn the function switch back to the STANDBY position. Check and reset the zero setting if necessary. If this setting is changed, recheck the calibration setting.

NOTE: To conserve calibration gas, this cylinder should be opened until a steady reading is secured and any adjustment is made (1 min.). This is the most efficient use of the calibration gas cylinder. Do not use the cylinder below about 30 PSIG as the reading can deviate up to 10% from the rated value. Safely discard the disposable cylinder when empty. If questions arise about disposal, this cylinder contained 99.99% pure air with 100ppm Isobutylene (non-toxic, non-flammable impurity).

If the span setting resulting from calibration is 0.0 or if the calibration cannot be achieved then the lamp must be cleaned (see Section 4-3 and 6-2.1).

If the analyzer still cannot be calibrated (the lamp may be ON but the output too low) or if the lamp has failed it must be replaced.

To replace the lamp, disassemble the probe, remove the old lamp, install a new one and reassemble. Set the SPAN pot to 8.0. Remove the readout assembly case (see Section 6-2.2). Locate the gain control potentiometer, R48, on the power supply board as shown on Figure 5-2. Recalibrate the analyzer adjusting this potentiometer, R48, with a small screwdriver to obtain the specified ppm reading.

If the analyzer still cannot be calibrated, it is possible that it may be leaking. The HW 101 normally operates at approximately 775 mbars +/- 30 mbars, and if not reassembled properly can leak.

#### NOTES:

- 1) The screws holding the end cap are special screws with rubber gaskets in the head.
- 2) The ion chamber has a special gasket on the screen retainer.
- 3) The filter nozzle must have its gasket in place where it connects with the probe. (The filter nozzle should not be disassembled either for filter replacement or general cleaning)

WARNING

Use great care when operating the analyzer with readout assembly outside the case due to the presence of -1200 V DC.

When calibration is accomplished, turn the analyzer OFF and replace the readout assembly in its case.

Adjustment of R48 potentiometer is used only when a new lamp is installed. At all other times adjustment is accomplished using the SPAN control potentiometer.

TABLE 4-1  
SCHEDULED MAINTENANCE ACTION INDEX

<u>Periodicity</u>	<u>Maintenance Action</u>	<u>Reference para.</u>
As required	Battery recharge	4-2
Monthly (or as required)	UV Lamp and Ion Chamber	4-3
Daily	Calibration	4-4

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**SAMPLING CONTAINERIZED LIQUID, SLUDGE, AND SLURRY**

**SOP NO. 008**

**REVISION NO. 2**

Approved by:

Katherine M. Horner  
Quality Assurance Officer

5/18/93  
Date



Title: **Sampling Containerized Liquid,  
Sludge, and Slurry**

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## **1.0 BACKGROUND**

Taking samples of liquid, sludge, and slurry from tanks, drums, or other containers can present some unique problems. Manmade containers are typically closed. Containers are usually accessed either through small ports, manways, hatches, taps, or bungs. The size, shape, construction material, and location of a container may limit the types of equipment and methods that can be used to collect samples.

### **1.1 PURPOSE**

The purpose of this standard operating procedure (SOP) is to establish and define the procedures that a sampling team will use when sampling liquid, sludge, and slurry from containers.

### **1.2 SCOPE**

Opening a closed container is a potentially hazardous task because toxic vapors and gases potentially could be released causing explosive reactions. Whenever containers that may contain hazardous materials are to be opened for sampling or any other reason, the sampling team will follow appropriate guidelines provided in site-specific sampling plans, health and safety plans, and the general guidelines in this SOP.

How containers are opened will depend on the purpose of the sampling, site conditions, the number, type and condition of containers, and the anticipated type of media to be sampled. As a result, no comprehensive procedures can be defined for sampling all types of containerized liquid, sludge, and slurry. This SOP provides general guidelines for handling problems that may be encountered while opening containers and sampling the media. General procedures are provided for sampling containerized liquid, sludge, and slurry using glass tubes and composite liquid waste samplers (COLIWASA).

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### 1.3 DEFINITIONS

**Bung Remover:** A device used to open the lid of a drum.

**COLIWASA:** Composite liquid waste sampler used to sample free-flowing liquids and slurries in containers.

**Photoionization Detector (PID):** A direct-reading air monitoring instrument used to measure organic vapors based on the principal of photoionization. Examples of PIDs include the HNu and the Microtip.

**Flame Ionization Detector (FID):** A direct-reading air monitoring instrument used to measure organic vapors based on the principle of flame ionization. An example of a FID is an organic vapor analyzer (OVA).

### 1.4 REFERENCES

American Society for Testing Materials. "Standard Recommended Practices for Sampling Industrial Chemicals." ASTM E-300-73.

deVera, E. R., and others. 1980. "Samplers and Sampling Procedures for Hazardous Waste Streams." EPA 600-80-018. January.

U.S. Environmental Protection Agency. 1981. "Technical Methods for Investigating Sites Containing Hazardous Substances." Technical Monographs 1-29 (draft). Ecology and Environment, Inc. June.

Title: Sampling Containerized Liquid,  
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## 1.5 REQUIREMENTS AND RESOURCES

Depending on container specifications and the method selected for collecting samples, the following equipment may be required:

- Glass tubes
- FID or PID
- Bung remover
- COLIWASA
- Rubber stopper
- Chain-of-custody forms and shipping materials
- Sample containers and labels
- Appropriate personal protective equipment (PPE)
- A permanent marker for labeling containers

## 2.0 PROCEDURES

Opening a closed container may potentially release toxic vapors and gases that could cause an explosive reaction. The decision to open a container to sample the contents should be made only after other potentially less dangerous site characterization methods, such as geophysical investigations or sampling of noncontainerized media, have been ruled out. In some cases, however, sampling the contents of the container may be necessary for use in legal cases or for other reasons.

When the decision to open a container has been made, the sampling team must assess potential exposure risks. Risk factors include the number, type, and condition of containers; site conditions that could prevent a container from being safely and efficiently opened; and the anticipated contents of the container. Based on this information and based on the scope of work for the work assignment, the sampling team will develop a safe procedure for opening the container and sampling its contents.

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Sampling team members must wear appropriate PPE when opening and sampling containers. In some cases, particularly when the contents of the container are not positively known, a remote drum opener may be used as outlined in SOP No. 054, "Geoprobe Sampling." After the container is opened, headspace gases should be monitored using an intrinsically safe monitoring instrument. At a minimum, a preliminary check using appropriate air-monitoring instruments will be conducted to help determine the level of PPE required and the appropriate sampling method.

Layering or stratification of any material left undisturbed over time is likely. Agitation of the container to homogenize the material can be difficult and is undesirable if the contents of the container are not known. The sampling team must ensure that samples represent the entire contents of the container, not just the contents of a single layer.

For sampling liquid and sludge in drums or other small to medium-sized containers, the glass tube sampling method is recommended. Tubes are available that collect a sample from the full depth of a drum and retain it until placement in a sample container. This sampling method is discussed in detail in Section 2.1 below. The COLIWASA is widely used to sample containerized and free-flowing liquids and slurries in drums, shallow tanks, pits, and other containers. It also is used for sampling immiscible liquid-phase waste. Use of the COLIWASA is outlined in Section 2.2. Section 2.3 discusses procedures applicable to sampling containerized liquid and sludge in large containers.

## **2.1 SAMPLING USING GLASS TUBES**

Glass tubes will be used to sample liquids and sludge in containers such as 55-gallon drums. Glass tubes designed for this purpose are normally 122 centimeters long and have an inside diameter of 6 to 16 millimeters (mm). Glass tubes with larger inside diameters are used for sampling viscous liquids. When sampling is completed, the glass tubes should be broken and disposed of in the container just sampled. This eliminates the need for cleanup and disposal. This sampling method requires a two-person sampling team.

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The glass tube method is a quick, relatively inexpensive way of sampling containerized liquid and sludge. The major disadvantage of this method is that some sample loss may occur when sampling less viscous liquids. Splashing of such liquids also can expose sampling team members to potentially hazardous materials. For this reason, appropriate PPE, such as a butyl rubber apron, a face shield, safety glasses, respirators, boot covers, and gloves must be worn when using the glass tube method.

All sampling equipment should be made of inert and nonreactive materials. Nondisposable equipment should be cleaned before and after each use. Refer to SOP No. 002, "Equipment Decontamination" for information on cleaning equipment.

The procedures for sampling liquids and sludge using the glass tube method are given below. Following these procedures, cautionary notes are provided.

**Sampling Containerized Liquids Using the Glass Tube Method**

1. Place all sampling equipment on a plastic sheet next to the container to be sampled.
2. Wear appropriate PPE. Use a PID or FID to monitor airborne organic vapors and gases in the breathing zone. In most cases, a PID is preferred because it is intrinsically safe, although an FID may be appropriate in some cases.
3. Record in the field logbook all exterior container markings, special conditions, and the type of opening through which the sample will be collected.
4. Using a permanent marker, make an identifying number on the container.
5. Place a completed label on an appropriate sample container (for example, a wide-mouthed, 8-ounce glass jar). Refer to SOP No. 018, "Sample Custody," for information on sample container labeling requirements. Refer to SOP No. 017, "Sample Collection Container Requirements" for information on appropriate sample containers.
6. Locate an existing opening or bung hole in the container, if possible.
7. Using nonsparking tools, a bung remover, or a remote drum opener carefully remove the cover or bung from the container.

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8. Slowly insert a glass tube to a level slightly above the bottom of the container. Keep at least 30 centimeters of the glass tube above the top of the container.
9. Allow the liquid in the container to reach its natural level in the glass tube.
10. Cap the top of the glass tube with a safety-gloved thumb or a rubber stopper.
11. Remove the capped glass tube from the container and insert the uncapped end in the labeled sample container.
12. Release the thumb or rubber stopper from the glass tube to allow the liquid to drain into the sample container.
13. Fill the sample container to approximately 90-percent of its capacity. Repeat steps 8 through 12 if more volume is needed to fill the sample container.
14. Carefully break the glass tube and dispose of it in the container just sampled.
15. Secure the sample container tightly with a Teflon<sup>®</sup>-lined cap. All liquid waste samples will be considered high-hazard samples.
16. Replace the bung in the container or seal the opening in the container with plastic.
17. Complete all chain-of-custody forms, and document all activities in the field logbook (SOP No. 018, "Sample Custody"). Unless the sample will be analyzed at the site, complete all high-hazard sample packaging requirements in accordance with SOP No. 019, "Packaging and Shipping Samples."

Sampling Containerized Sludge Using the Glass Tube Method

1. Follow steps 1 through 7 listed above.
2. Slowly insert a glass tube to a level slightly above the bottom of the container. Keep at least 30 centimeters of the glass tube above the top of the container.
3. Allow the liquid in the container to reach its natural level in the glass tube.
4. Gently push the glass tube into the sludge layer at the bottom of the container.
5. Cap the top of the glass tube with a safety-gloved thumb or a rubber stopper.

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6. Remove the capped glass tube from the container and insert the uncapped end in the labeled sample container (for example, a wide-mouthed, 8-ounce glass jar).
7. Release the thumb or rubber stopper from the glass tube to allow the material to drain into the sample container. If necessary, the sludge sample in the bottom of the tube may be dislodged using a stainless-steel spatula.
8. Fill the container to approximately 90-percent of its capacity. Repeat steps 2 through 7 if more volume is needed to fill the sample container.
9. Carefully break the tube and dispose of it in the container just sampled.
10. Secure the sample container tightly with a Teflon®-lined cap. All liquid waste samples will be considered high-hazard samples.
11. Replace the bung hole in the container or seal the opening in the container with plastic.
12. Complete all chain-of-custody forms and document sampling activities in field logbook (SOP No. 018, "Sample Custody"). Unless the sample is being analyzed at the site, complete all high-hazard sample packaging requirements in accordance with SOP No. 019, "Packaging and Shipping Samples."

**Cautionary Notes:**

- a. If you observe any reaction when the glass tube is inserted into the container (for example, violent agitation, smoke, light, or heat), leave the area immediately.
- b. If the glass tube becomes cloudy or smoky after inserting it into the container, hydrofluoric acid may be present. Glass tube sampling is inappropriate in this circumstance. Instead, use a comparable length of rigid plastic tubing to collect the sample.
- c. When solid material is encountered in a container (either a floating layer or bottom sludge), use the bottom sludge sampling procedure to collect a sample of the material. Alternatively, the material may be sampled with a disposable scoop attached to a disposable wooden or plastic rod.

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## 2.2 SAMPLING USING THE COLIWASA

The COLIWASA is used to collect samples of containerized or free-flowing liquid and slurry in drums, shallow tanks, pits, and other containers. The COLIWASA is commercially available; however, it can be handmade from a variety of materials, including polyvinyl chloride (PVC), glass, or Teflon®. It consists of a 152-centimeter-long tube with an inside diameter of 4 centimeters. The tube has a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the COLIWASA by raising and lowering the neoprene stopper. Like the glass tube method, use of the COLIWASA requires a two-person sampling team.

The recommended COLIWASA design is shown on Figure 1. The design may be modified to meet the needs of a sampling situation. The major drawbacks of using a COLIWASA involve decontamination problems and cost. The COLIWASA is difficult to decontaminate, and its high cost makes its treatment as a disposable item impractical. However, it has significant uses when accurate representation of a multiphase waste is necessary.

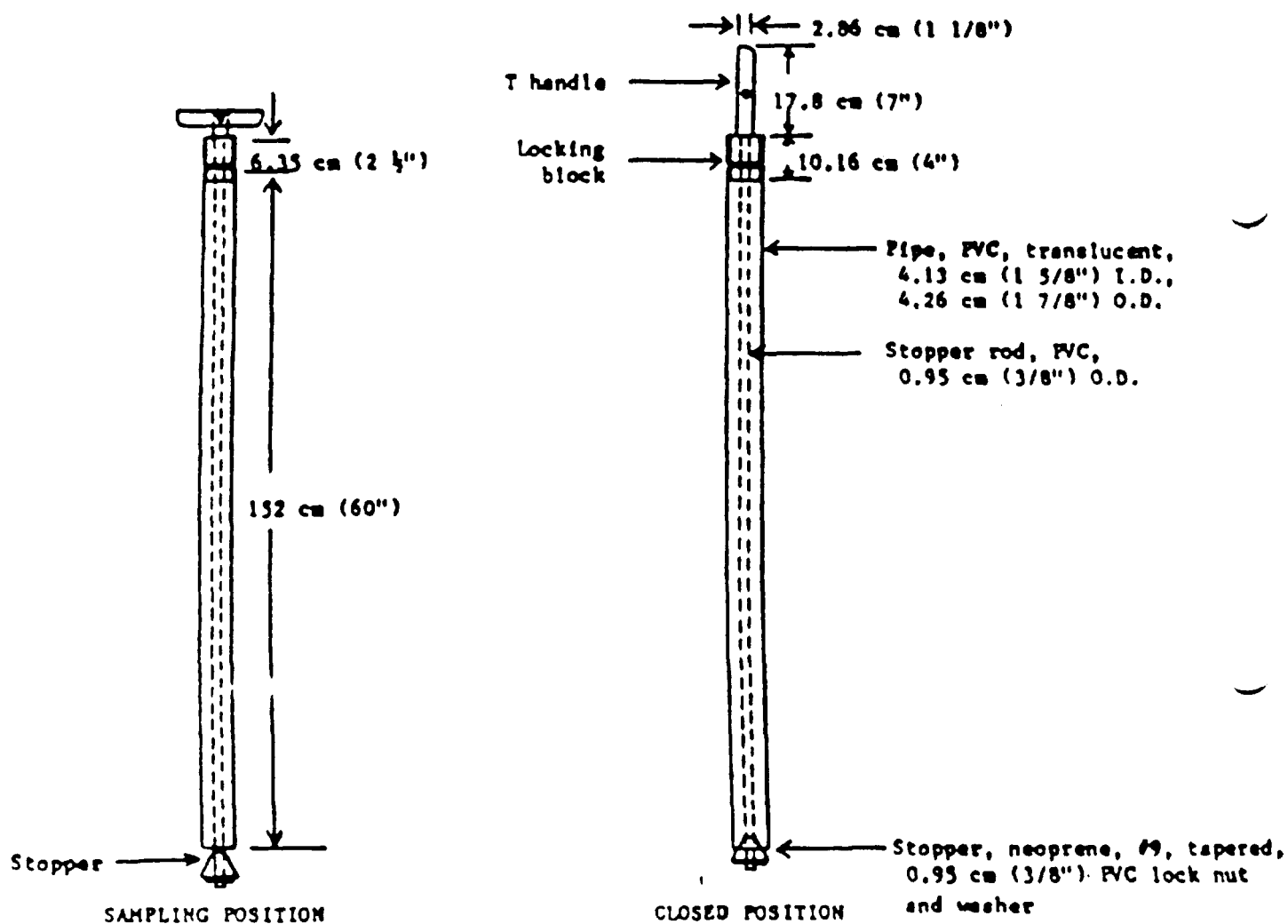
The procedure for sampling containerized liquid or slurry using the COLIWASA is given below.

1. Choose the material to make the COLIWASA (for example, PVC, glass, or Teflon®). Assemble the sampler as shown on Figure 1.
2. Clean the COLIWASA according to procedures specified in SOP No. 002, "Equipment Decontamination." Place all sampling equipment on a plastic sheet next to the container to be sampled.
3. Check the COLIWASA to make sure it is functioning properly. Adjust the locking mechanism so that the neoprene stopper provides a tight closure.
4. Wear appropriate PPE. Use a PID or FID to monitor airborne organic vapors and gases in the breathing zone. In most cases a PID is preferred because it is intrinsically safe, although an FID may be appropriate in some cases.
5. Record exterior container markings, special conditions, and the type of opening through which the sample will be collected in the field logbook.



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FIGURE 1  
COLIWASA



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6. Using a permanent marker, make an identifying number on the container.
7. Place a completed label on an appropriate sample container. Refer to SOP No. 017, "Sample Collection Container Requirements," and SOP No. 018, "Sample Custody."
8. Locate an existing opening or a bung hole in the container, if possible.
9. Using nonsparking tools, a bung remover, or a remote drum opener carefully remove the cover or bung from the container.
10. Place the COLIWASA in the open position. The stopper rod handle should be in the T position, and the rod should be pushed down until the handle rests against the locking block.
11. Lower the COLIWASA into the liquid or slurry. Proceed at a rate that permits the levels of the liquid or slurry inside and outside the COLIWASA tube to be about the same. If the liquid or slurry level in the COLIWASA tube is lower than that outside the COLIWASA tube, the sampling rate is too fast and will produce a nonrepresentative sample.
12. When the stopper reaches the bottom of the container, push the COLIWASA tube downward against the stopper to close it. Lock the COLIWASA tube in the closed position by turning the stopper rod handle from the T position until it is upright and one end rests tightly against the locking block.
13. Remove the COLIWASA tube from the container and it with a disposable cloth.
14. Pour the sample into a sample container. To do this, slowly pull the lower end of the stopper rod handle away from the locking block while the lower end of the COLIWASA tube is positioned in the sample container.
15. Secure the sample container with a Teflon®-lined cap. All liquid waste samples are to be considered high-hazard samples.
16. Complete all chain-of-custody documents (SOP No. 018, "Sample Custody") and record sampling activities in the field logbook. Unless the sample is to be analyzed at the site, complete all high-hazard sample packaging requirements according to SOP No. 019, "Packaging and Shipping Samples."
17. Replace the bung in the container, if possible, or seal the opening in the container with plastic.
18. Unscrew the stopper rod handle of the COLIWASA tube and disengage the locking block. Decontaminate the COLIWASA tube on site or store contaminated parts in a plastic storage tube for subsequent decontamination (SOP No. 002, "Equipment Decontamination").

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### 2.3 SAMPLING LARGE CONTAINERS

For containers greater than 1 meter deep, the glass tube and COLIWASA tube methods can not be used to collect liquid or sludge. To collect samples from large containers, a suction line should be lowered into the container, and a sample should be collected using a peristaltic pump. Discrete samples may be collected from various depths and combined or analyzed separately. If contents of the container are known and do not present a hazard, a small, submersible pump may be used instead of a peristaltic pump.

**SOP APPROVAL FORM**

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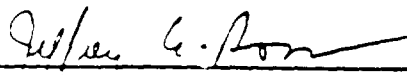
**STANDARD OPERATING PROCEDURE**

**GROUNDWATER SAMPLING**

**SOP NO. 010**

**REVISION NO. 3**

Approved by:

  
\_\_\_\_\_  
Quality Assurance Officer

2/19/93  
\_\_\_\_\_  
Date

## 1.0 BACKGROUND

Groundwater sampling may be required for a variety of reasons, such as examining potable or industrial water supplies, checking for and tracking contaminant plume movement in the vicinity of a land disposal or spill site, RCRA compliance monitoring, or examining a site where historical information is minimal or nonexistent, but where it is thought groundwater may be contaminated.

Groundwater is usually sampled through an in-place well, either temporarily or permanently installed. However, it can also be sampled anywhere groundwater is present, such as a pit or a dug or drilled hole.

Occasionally, a well will not be in the preferred location to obtain the sample needed (for example, to track a contaminant plume). In such a case, a temporary or permanent well will have to be installed. An experienced and knowledgeable person, preferably a hydrogeologist, will need to locate the well and supervise its installation so that the samples ultimately collected will be representative of the groundwater.

### 1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedure for determining the quality of groundwater entering, leaving, or affected by site activities through groundwater sampling. The samples are obtained by retrieving water from a well placed into the underlying aquifer or aquifers at a site.

### 1.2 SCOPE

This SOP applies to all groundwater sampling activities conducted in the field.

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### 1.3 DEFINITIONS

**Bailer** -- A cylindrical sampling device with valves on either end used to extract water from a well. Bailers are usually constructed of an inert material such as stainless steel or polytetrafluoroethylene (Teflon). The bailer is lowered and raised by means of a cable that may be cleaned and reused, or by disposable rope.

**Electrical Water Level Indicator** -- An electrical device that has a light or sound alarm connected to an open circuit used to determine the depth to fluid. The circuit is closed when the probe intersects a conducting fluid. The wire used to raise and lower the probe is usually graduated.

**Immiscible Phase** -- Liquid phases that cannot be uniformly mixed or blended with water. Heavy immiscible phases sink; light immiscible phases float on water.

**Interface Probe** -- An electrical probe that determines the distance from the surface to air/water, air/immiscible, or immiscible/water interfaces.

**Purge Volume** -- The volume of water that needs to be removed from the well to insure that a sample representative of the groundwater is taken.

**Riser Pipe** -- The length of well casing above the ground surface.

**Total Well Depth** -- The distance from the ground surface to the bottom of the well.

**Water Level** -- The level of water in a well. Measured as depth to water or as elevation of water, relative to a reference mark or datum.

Date of Original Issue: 03/31/91

Revision Date: 01/31/93

Title: Groundwater Sampling

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## 1.4 REFERENCES

Korte, N. P. Kearl, Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition, GJ/TMC-08, U.S. Department of Energy, Technical Measurements Center, Grand Junction Projects Office, 1985.

U.S. EPA, "Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities," EPA-530/SW-611, August 1977.

U.S. EPA, "Sampling at Hazardous Materials Incidents," EPA Hazardous Response Support Division, Cincinnati, 1984.

U.S.G.S., 1984, National Handbook of Recommended Methods for Water-Data Acquisition, Reston, VA.

## 1.5 REQUIREMENTS AND RESOURCES

There are various options available to obtain groundwater samples. The procedures are outlined in the following section. The equipment needed for these procedures includes:

- Organic vapor detector with a flame ionization detector (FID) or photoionization detector (PID)
- Pipe wrench
- Electrical water level indicator or interface probe
- Steel tape with heavy weight
- Purging device (type needed depends on well depth, casing diameter, type of sample desired - see sampling devices below)
- Sampling device (type needed depends upon depth to water and type of sample desired)
  - Teflon bailer
  - Stainless steel bailer
  - Teflon bladder pump
  - Stainless steel submersible (nonoil-bearing) pump
  - Existing dedicated equipment
  - Peristaltic pump

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- Sample containers
- Wastewater containers with adequate volume
- Logbook
- Stopwatch

Additional equipment is required to complete measurement of field parameters (i.e., pH, specific conductance, and temperature) of the groundwater at the well (refer to SOP No. 061).

## 2.0 PROCEDURE

Prior to sampling, a site-specific sampling plan will be developed. The plan will take into consideration the site characteristics and will include:

- The specific repeatable well measurement techniques and reference points for determining the depth to water and the depth to bottom of the well
- The specific method of purging and selection of purging equipment
- The specific analytical method for measurement of field parameters and the selection of field analytical equipment
- The specific method of sample collection and selection of sampling equipment
- The order of sample bottle filling
- The sample chemical analytical parameters

### 2.1 APPROACHING THE WELL

In general, all wells should be assumed to pose a health and safety risk until field measurements determine otherwise. Approach wells from the upwind side. Record well appearance and general condition of the protective casing, surface seal, and surrounding area in the logbook.



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Once at the well, the lead person should systematically use the organic vapor detector to survey the immediate area around the well (from the breathing zone to the top of the casing to the ground). If elevated FID and PID meter readings are encountered, retreat to a safe area and instruct the sampling team to put on the appropriate level of personal protective equipment (PPE).

Upon opening the well casing, the lead person should systematically survey inside the well casing above the well casing in the breathing zone and the immediate area around the well. If elevated FID or PID meter readings in the breathing zone are encountered, (see health and safety plan for action levels) retreat and put on appropriate PPE. It is important to remember that action levels are based on readings in the breathing zone, not within the well casing. Representative organic vapor detector readings will be recorded in the logbook.

## 2.2 ESTABLISHING A SAMPLE PREPARATION AREA

The sample preparation area is generally located upwind or to either side of the well. If elevated readings are encountered using an organic vapor detector, this area should be taped off and the sample preparation area should be located upwind where ambient readings are found.

## 2.3 PRELIMINARY WELL MEASUREMENTS

Several preliminary well measurements should be made prior to initiating sampling of the well. These include determining water level and total well depth measurements, determining the presence of identifiable phases, and calculating purge volumes. All preliminary measurements will be recorded in the logbook as they are determined.

### 2.3.1 Water Level and Total Well Depth Measurements

PRC typically uses an electric water-level indicator for water level measurements. This device sounds an alarm or illuminates a light when the measuring probe touches the water surface, thus closing an electrical circuit. The electric cable supporting the probe is usually graduated in feet and can be read at the well site directly. The remaining fraction is measured with a steel tape graduated to 0.01 foot. The distance between the static water level and the marked or notched

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location at the top of the riser pipe is measured. The height of the riser pipe above ground surface, as obtained from well location survey data, is then subtracted from the total reading to give the depth to static water. To improve the accuracy of the readings, each measurement should be for a series of three readings, and the values averaged. This helps to eliminate any errors from kinks or bends in the wires, which may change the length when the device is pulled up and let down.

The total well depth can be measured by using a steel tape with a heavy weight attached to the end. The tape is lowered into the well until resistance is met, indicating that the weight has reached the bottom of the well. The total well depth is then read directly from the steel tape to the 0.01 foot fraction. The distance between the bottom of the well and the marked or notched location on the riser pipe is measured. The height of the riser pipe above the ground surface, as obtained from well survey data, is then subtracted from the total reading to give the depth to the bottom of the well. To improve the accuracy of the readings, the weighted steel tape should be used to make a series of three readings, and the readings averaged.

### **2.3.2 Determining If Immiscible Phases Are Present**

If immiscible phases (organic floaters or sinkers) are present, the following measurement activities should be undertaken. Organic liquids are measured by lowering an interface probe slowly to the surface of the liquid in the well. When the audible alarm sounds, record the depth. If the alarm is continuous, a floating immiscible layer has been detected. To determine the thickness of this layer, continue lowering the probe until the alarm changes to an oscillating signal. The oscillating signal indicates that the probe has detected an aqueous layer. Record this depth as the depth to water and determine the thickness and the volume of the immiscible layer.

Continue lowering the probe into the well to determine if immiscible dense phases (sinkers) are present. If the alarm signal changes from oscillating to a continuous sound, a heavier immiscible layer has been detected; record this depth.

Continue lowering the probe to the bottom of the well and record the total depth. Separate total depth measurements with a steel tape are not necessary when using an interface

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probe. Calculate and record the sinker phase volume and total water volume in the well. A chart is provided in Table 1 to assist in these calculations. If immiscible phases are present, immediately refer to Sections 2.5.1 or 2.5.2 of this SOP.

### 2.3.3 Determination of Purging Volume

If the presence of floaters or sinkers does not need to be determined, determine the depth to water and the total depth of the well as described in Section 2.3.1. Once these measurements have been made and recorded, use Table 1 to calculate the total volume of water in the well. Multiply this volume by the purging factor to determine purging volume. The minimum purging factor is three casing volumes but may be superseded by site-specific program requirements, individual well yield characteristics or stabilization of field parameters measured during purging. Field parameters (i.e., pH, specific conductance, and temperature) should be measured in accordance with SOP No. 061 prior to purging and after each well volume. All field parameter data are recorded in the field logbook.

In Table 1, the volume of water in a 1-foot section of a 2-inch-diameter well is 0.16 gallon. This chart can easily be used for any water depth by multiplying all the values in Table 1 by the L value (depth, in feet, of water in the well).

## 2.4 PURGING THE WELL

Currently, PRC standards allow for six options for purging wells:

- 1) Teflon bailers
- 2) Stainless steel bailers
- 3) Teflon bladder pumps
- 4) Stainless steel submersible (nonoil-bearing) pumps

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TABLE 1  
LIQUID VOLUME IN A 1-FOOT SECTION OF WELL CASING

Well Casing Inside Diameter (D) (inches)	Volume of Liquid in 1-Foot well Section (gallons) $V = 0.0408 (D^2)$
1	0.041
1.5	0.092
2	0.163
3	0.367
4	0.653

The volume of water in the well is based on the formula:

$$V = \frac{\pi \times D^2}{4} \times L$$

where:

- D = the inside diameter of the well in inches
- L = the depth in feet of the water in the well
- V = the volume of water in the well in cubic feet

- 5) Existing dedicated equipment (use of these devices must be approved by on-site client representatives)
- 6) Peristaltic pumps (these devices are for use in shallow wells only and must be approved by the on-site client representative)

As previously stated, the established minimum purging volume is three casing volumes. The exception to this standard is in the case of low-yield wells. When purging low-yield wells, purge the well once to dryness. Samples should be collected as soon as the well recovers. When the time required for full recovery exceeds 3 hours, samples should be collected as soon as sufficient volume is available.

The well should be purged until the measured field parameters have been stabilized. If any field parameter has not stabilized, additional purging should be performed. To be considered stable, field parameters should change by no more than the tolerance levels listed on Table 2 between each well volume purged.

**TABLE 2**  
**FIELD MEASUREMENT TOLERANCE LEVELS**

Field Parameter	Tolerance Level
pH	0.1 pH units
Specific Conductance	10% RPD
Temperature	1°C
RPD	Relative percent difference
°C	Degrees Celsius

At no time should the purging rate be high enough to cause the groundwater to cascade back into the well, resulting in excessive aeration and potential stripping of volatile constituents.

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The actual volume of purged water can be measured using several acceptable methods:

- When bailers are used, the actual volume of each bailer's contents can be measured using a calibrated bucket.
- If a pump is used for purging, the pump rate can be determined by using a bucket, stopwatch, and the duration of pumping until the necessary volume is purged.

## 2.5 SAMPLE COLLECTION

The technique used to withdraw a groundwater sample from a well should be selected based on the parameters for which the sample will be analyzed. To ensure that the groundwater samples are representative, it is important to avoid physically altering or chemically contaminating the sample during collection, withdrawal, or containerization. If the samples are to be analyzed for volatile organic compounds, it is critical that air does not become entrained in the water column.

Acceptable sampling devices for all parameters include double check valve stainless steel or Teflon bailers, bladder pumps, low-flow positive displacement pumps, or for shallow wells peristaltic pumps. Additional field measurements should be performed at the time of sampling. Refer to SOP No. 061.

In some cases, it may become necessary to use dedicated equipment already in the well to collect samples. This is particularly true of high volume, deep wells (>150 feet) where bladder pumps are ineffective, and bailing is impractical. If existing equipment must be used, determine the make and model of the pump, and obtain information on component construction materials from the manufacturer or facility representatives. If an existing pump is to be used for sampling, make sure the flow volume can be reduced so that a reliable volatile organics analysis (VOA) sample can be taken. Record which specific port, tap, or valve sample is collected from.

General sampling procedures include the following:

- Clean sampling equipment should not be placed directly on the ground. Use a plastic drop cloth or feed line from clean reels. Never place contaminated lines back on reels.
- Check the operation of the bailer check valve assemblies to confirm free operation.
- If the bailer cable is to be decontaminated and reused, it must be made of Teflon-coated stainless steel.
- Lower sampling equipment slowly into the well to avoid degassing the water and damaging the equipment.
- Pump flow rates should be adjusted to eliminate intermittent or pulsed flow. The settings should be determined during the purging operations.
- A separate sample volume should be collected to measure field parameters. Samples should be collected and containerized in the order of the parameters' volatilization sensitivity. Table 3 lists the preferred collection order for some common groundwater parameters.

**TABLE 3**  
**ORDER OF PREFERRED SAMPLE COLLECTION**

- 
- |     |                                  |
|-----|----------------------------------|
| 1.  | Volatile organics (VOA)          |
| 2.  | Purgeable organic halogens (POX) |
| 3.  | Total organic halogens (TOX)     |
| 4.  | Cyanide                          |
| 5.  | Extractable organics             |
| 6.  | Purgeable organic carbon (POC)   |
| 7.  | Total metals                     |
| 8.  | Dissolved metals                 |
| 9.  | Total organic carbon (TOC)       |
| 10. | Phenols                          |
| 11. | Sulfate and chloride             |
| 12. | Nitrate and ammonia              |
| 13. | Radionuclides                    |
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Intermediate containers should never be used to prepare VOA samples and should be avoided for all parameters in general. All VOA containers should be filled at a single sampling point or from a single bailer volume.

#### **2.5.1 Collection of Light Immiscible Floaters**

The approach used when collecting floaters is dependent on the depth to the floating layer and the thickness of that layer. If the thickness of the floater is 2 feet or greater, a bottom-filling valve bailer should be used. Slowly lower the bailer until contact is made with the floater surface, and lower the bailer to a depth less than that of the floater/water interface depth as determined by preliminary measurements with the interface probe.

When the thickness of the floating layer is less than 2 feet and the depth to the surface of the floating layer is less than 15 feet, a peristaltic pump can be used to extract a sample.

When the thickness of the floating layer, however, is less than 2 feet and the depth to the surface of the floating layer is beyond the effective "lift" of a peristaltic pump (greater than 25 feet), a bailer can be modified to allow filling from the top only (an acceptable alternative is to use a top-loading Teflon or stainless steel bailer). Disassemble the bailer's bottom check valve and insert a piece of 2-inch-diameter Teflon sheet between the ball and ball seat. This will seal off the bottom valve. Remove the ball from the top check valve, thus allowing the sample to enter from the top. To overcome buoyancy when the bailer is lowered into the floater, place a length of one-inch stainless steel pipe on the retrieval line above the bailer (this pipe may have to be notched to allow sample entry if the pipe remains within the top of the bailer). Or, as an alternative, use a top-loading stainless steel bailer. Lower the device, carefully measuring the depth to the surface of the floating layer, until the top of the bailer is level with the top of the floating layer. Lower the bailer an additional one-half thickness of the floating layer and collect sample. This technique is the most effective method of collection if the floating layer is of only a few inches thick.



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### 2.5.2 Collection of Heavy Immiscible Sinkers

The best method for collection of sinkers is use of a double check valve bailer. The key to collection is slow, controlled, lowering and raising of the bailer to and from the bottom of the well. Collection methods are equivalent to those described in Section 2.5.1 above. Note that both floaters and sinkers must be collected prior to any purging activities.

### 2.5.3 Collection of Volatile Organics Samples

This section discusses the collection of VOAs using either a bailer or bladder pump in detail. Other pumps (such as positive displacement or peristaltic) can be used. Critical to the collection of representative samples for volatile organics analysis are ensuring that no air has become entrained in the water column, low pump flow rates (less than 100 milliliter (mL) per minute, if possible), and avoiding flow surges.

#### 2.5.3.1 Collection with Bailers

VOAs should be collected from the first bailer removed from the well after purging. The most effective means requires two people. One person should retrieve the bailer from the well and pour its contents into the appropriate number of 40-mL VOA vials held by the second person. Cap the vial and invert. If a bubble exists, discard and repeat. Do not reopen the vial and add additional sample. The sample is transferred from the bailer to the container in a manner that will limit the amount of agitation in order to reduce the loss of volatile organics from the sample.

Always fill VOA vials from a single bailer volume. If the bailer is refilled, samples are not duplicates or splits.

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#### 2.5.3.2 Collection with a Bladder Pump (Well Wizard)

To successfully perform VOA sampling with a Well Wizard bladder pump, the following steps must be completed:

- 1) Following manufacturer's directions, activate the Well Wizard pump. Full water flow from the discharge tubing will begin after 5 to 15 pumping cycles. These initial pumping cycles are required to purge air from the pump and discharge tubing. The discharge and recharge settings must be manually set and adjusted to pump at optimum flow rates. To activate the bladder, it is best to set the initial cycle at long discharge and recharge rates.
- 2) Reduce water flow rate for VOA sample collection. To reduce the water flow rate, turn the throttle control valve (located on the left side of the Well Wizard pump control panel) counterclockwise.
- 3) Collect VOA sample from discharge tubing. VOA vials must be placed beneath the discharge tubing while avoiding direct contact between the vials and the tubing. Never place tubing past the mouth of the VOA vial. The pump throttle control must be turned as necessary to maintain a trickle of water in order to obtain a meniscus in the vial.
- 4) Continue with non-VOA sampling. Increase pump flow rate by turning the throttle control knob clockwise.

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**


**STANDARD OPERATING PROCEDURE**

**STATIC WATER LEVEL, TOTAL WELL DEPTH,  
AND IMMISCIBLE LAYER MEASUREMENT**

**SOP NO. 014**

**REVISION NO. 0**

Approved by:

  
\_\_\_\_\_  
Quality Assurance Officer

7/20/94  
\_\_\_\_\_  
Date

Date of Original Issue: 07/20/94

Title: **Static Water Level, Total Well Depth, and  
Immiscible Layer Measurement**

## **1.0 BACKGROUND**

Measurement of static water level, total well depth, and any immiscible layers is necessary before a well can be sampled and groundwater flow direction can be determined. If an immiscible layer is present, its depth and thickness must be determined. In addition, the static water level and total well depth of a monitoring well are needed to determine a purging volume.

### **1.1 PURPOSE**

The purpose of this standard operating procedure (SOP) is to provide guidelines for field personnel measuring static water levels and total water depths of monitoring wells or piezometers. This SOP also provides guidelines for measuring immiscible layers in such wells.

### **1.2 SCOPE**

This SOP describes the methodologies for measuring static water level, total well depth, and immiscible layer depth and thickness.

### **1.3 DEFINITIONS**

To clarify the methodologies presented in this SOP, the following definitions are presented:

**Electrical Water Level Indicator** -- An electrical probe used to determine the depth to fluid. The probe has a light or sound alarm connected to an open circuit. The circuit is closed and the alarm is activated when the probe contacts a conducting fluid such as water.

**Immiscible Layer** -- A liquid phase that cannot be uniformly mixed or blended with water. Heavy immiscible phases sink in water; light immiscible phases float on water.

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**Interface Probe** – An electrical probe used to determine the thicknesses of light or dense immiscible layers in the water column of a monitoring well.

**Ionization Detector** – A photoionization detector (PID) or a flame ionization detector (FID) is used to measure the level of volatile organic compounds in the gaseous phase. These units are generally not compound-specific and thus measure only total volatile organic compounds. The PID generally cannot detect as complete a range of compounds as the FID. This difference is the result of the relative ionization energies of the two detectors. Most PIDs cannot detect methane, but FIDs can. The HNu and Microtip are examples of PIDs; the Foxboro organic vapor analyzer (OVA) is an example of an FID.

**Static Water Level** – The level of water in a monitoring well or piezometer. This level can be measured as the depth to water or as the elevation of water relative to a reference mark or datum.

**Total Well Depth** – The distance from the ground surface to the bottom of a monitoring well or piezometer

#### 1.4 REFERENCES

SOP No. 002, General Equipment Decontamination, is referenced in this SOP.

#### 1.5 REQUIREMENTS AND RESOURCES

The equipment required for measuring static water levels, total well depths, and immiscible layers is as follows:

- Electrical water level indicator
- Interface probe
- PID or FID

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## **2.0 PROCEDURES**

This section provides general guidance followed by specific procedures for static water level, total well depth, and immiscible layer measurement.

Techniques for measuring depth to water and depth to the bottom of a monitoring well should be identified in the planning stage of field work. Also at this stage, measuring devices should be chosen, and an individual should be assigned to take and record measurements.

All measurement instruments should be decontaminated before and after use and between measurement locations. Refer to SOP No. 002, General Equipment Decontamination.

Before initiation of any measuring activities, the ambient air at a monitoring well head should be monitored for possible emissions of volatile organic compounds. To accomplish this monitoring, a PID or an FID should be used. The health and safety plan for on-site activities should provide action levels and the rationale for selection of either detector.

Appropriate respiratory protection equipment should be worn by the sampling team. Wells should be approached from the upwind side. When opening the monitoring well, the sampling team should systematically survey the inside of the well casing, the area from the casing to the ground, the area from above the well casing to the breathing zone, and the area around the well. Readings for comparison to action levels should be taken not within the well casing but in the breathing zone. If PID or FID readings of volatile organic compounds are above action levels, the sampling team should retreat to a safe area and put on appropriate safety gear. The site-specific health and safety plan should be consulted for action levels.

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## **2.1            STATIC WATER LEVEL MEASUREMENT**

The procedure described below should be followed to measure the static water level in a monitoring well or piezometer.

An electric water level indicator is typically used for static water level measurement. The electrical probe of the indicator should be lowered into the monitoring well until the light or sound alarm is activated, indicating that the probe has touched the water surface. The static water level should then be read directly from the indicator to the 0.01-foot fraction. If the monitoring well top is not flush with the ground surface, the distance between the static water level and the top of the riser pipe should be measured; the height of the riser pipe above ground surface should then be subtracted from the first measurement to determine the depth to static water below grade. If surveyed elevations are available, they should be used to establish the water level elevation. To ensure measurement accuracy, the probe should be left hanging above the water surface in the monitoring well; a series of three readings should be taken, and the values should be averaged. The date and time of taking the readings with the readings and average value should be recorded in a field logbook.

## **2.2            TOTAL WELL DEPTH MEASUREMENT**

The procedure described below should be followed to measure total well depth in a monitoring well or piezometer.

Total well depth measurement can be performed also using an electric water level indicator. The electrical probe of the indicator should be lowered into the monitoring well until resistance is met, indicating that the probe has reached the bottom of the well. The total well depth should then be read directly from the indicator to the 0.01-foot fraction. If the monitoring well top is not flush with the ground surface, the distance between the bottom of the well and the top of the riser pipe should be measured; the height of the riser pipe above ground surface should then be subtracted from the first measurement to determine the depth to the bottom of the well. To ensure measurement accuracy, the

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probe should be left hanging above the water surface in the monitoring well; a series of three readings should be taken, and the values should be averaged. The date and time of taking the readings with the readings and average value should be recorded in a field logbook.

### **2.3 IMMISCIBLE LAYER DETECTION AND MEASUREMENT**

The procedure described below should be followed to detect and measure an immiscible layer in a monitoring well.

A light immiscible layer in a monitoring well can be detected by slowly lowering an interface probe to the surface of the water in the well. When the audible alarm sounds, the depth of the probe should be recorded. If the alarm is continuous, a light immiscible layer has been detected. To measure the thickness of this layer, the probe should then be lowered until the alarm changes to an oscillating signal. The oscillating alarm indicates that the probe has reached a water layer. The probe depth at the time the alarm begins oscillating should be recorded as the depth to water. The thickness of the light immiscible layer should then be determined by subtracting the depth at which a continuous alarm occurred from the depth at which the alarm began to oscillate. To ensure measurement accuracy, the interface probe should be left hanging above the water surface in the monitoring well; a series of three readings should be taken, and the depths and thicknesses measured should be averaged. The date and time of taking the readings with the depths and thicknesses should be recorded in a field logbook.

To determine whether a dense immiscible layer is present, the interface probe should be lowered further into the monitoring well. If the alarm changes from an oscillating to a continuous signal, a heavier immiscible layer has been detected, and the probe depth should be recorded at that point. Total well depth obtained in Section 2.2 should be used for calculating the thickness of the dense layer. The dense layer should be calculated by subtracting the depth at which the alarm became continuous from the total well depth. This procedure provides an estimate of the thickness of the dense layer in the monitoring well. To ensure measurement accuracy, the interface probe should be



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left hanging above the water surface in the monitoring well; a series of three readings should be taken, and the depths and thicknesses measured should be averaged. The date and time of taking the readings with the depths and thicknesses should be recorded in a field logbook.

**SOP APPROVAL FORM**

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**PRC ENVIRONMENTAL MANAGEMENT, INC.**

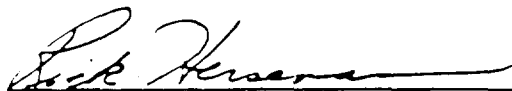
**STANDARD OPERATING PROCEDURE**

**SAMPLE PRESERVATION AND MAXIMUM HOLDING TIMES**

**SOP NO. 016**

**REVISION NO. 3**

Approved by:



Quality Assurance Officer

7/11/94

Date

## 1.0 BACKGROUND

Methods of preservation are generally intended to retard biological action and hydrolysis of chemical compounds and complexes. Preservation also reduces the loss of constituents by volatilization and the effects of adsorption and absorption. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and freezing.

Often the sampler will need to split the sample into several different aliquots, specifying different sample containers and preservation methods for each aliquot based on the analyses of interest.

Overall, solid samples, including soils, are usually delivered to the laboratory unpreserved or after being preserved by cooling to 4 °C. Air samples are usually unpreserved. Biological samples are preserved, but their preservation methods are detailed in a separate standard operating procedure (SOP).

Recommended preservatives for various constituents in water are given in Table 1 presented at the end of this document. Preservation techniques for water samples requiring more than simple refrigeration or filtering are discussed in Section 2.0. Other information provided in Table 1 includes the suggested type of container and the maximum recommended holding times for samples that are properly preserved.

Table 2, also presented at the end of this document, includes the container size required for the different types of analyses and gives further details on sample preservation. These guidelines should be followed in all sampling events unless the client or its laboratory requests otherwise. All deviations will be noted in the site-specific sampling plan or field logbook.

### 1.1 PURPOSE

This SOP establishes the requirements and procedures for preserving environmental samples.

## 1.2 SCOPE

This SOP applies to sample preservation, maximum holding times, and container type and sizes required for environmental samples. The requirements for inorganic and organic sample preservation are described. These procedures fulfill the U.S. Environmental Protection Agency's (EPA) quality assurance/quality control (QA/QC) requirements for routine analytical services (RAS) and many special analytical services (SAS).

Largely, this SOP concerns itself with the complexities of preserving environmental water samples. Preservation of solid, soil, and air samples is discussed only in Section 2.1. Preservation of biological samples is discussed in a separate SOP.

## 1.3 DEFINITIONS

**Environmental Samples:** Environmental samples are those samples corresponding to the CLP low-concentration designation. They are generally dilute samples in terms of pollutant concentration and are typically taken in an area surrounding a spill or dump site.

**Hazardous Samples:** Hazardous samples correspond to the CLP medium- or high-concentration designations. Typically, they are samples collected from drums, tanks, lagoons, pits, waste piles, and fresh spills.

## 1.4 REFERENCES

American Public Health Association (APHA). 1989. *Standard Methods for the Examination of Water and Wastewater*. 17th ed.

U.S. Environmental Protection Agency (EPA). 1983. "Methods for the Chemical Analysis of Water and Wastes." EPA-600/4-79-020. March.

EPA. 1983. *RCRA Permit Writer's Manual: Ground-Water Protection (40 C.F.R. Part 264, Subpart F)* Geotrans, Inc. EPA Contract No. 68-01-6464.

EPA. 1984. *Federal Register*. Volume 49. Number 209. p 43260, October 26. 1984.

EPA. 1986. "Test Methods for Evaluating Solid Waste Physical/Chemical Methods." SW-846.

EPA/National Water Well Association (NWWA). 1981. *Manual of Ground-Water Sampling Procedures*. NWWA/EPA series.

## 1.5 REQUIREMENTS AND RESOURCES

The following equipment may be required for sample preservation:

- Sample containers, glass or plastic, as permitted in Table 1 and specified in the site-specific sampling plan
- Preservatives, as specified in Table 1, for the samples. These may include:
  - Ice or a refrigerator (Cool, 4 °C)
  - Concentrated hydrochloric acid (HCl)
  - Concentrated nitric acid (HNO<sub>3</sub>)
  - Concentrated phosphoric acid (H<sub>3</sub>PO<sub>4</sub>)
  - Concentrated sulfuric acid (S<sub>2</sub>SO<sub>4</sub>)
  - 10 N sodium hydroxide (NaOH) solution. Either use a commercial solution or dissolve 400 grams NaOH in water and dilute to 1 liter .
  - 2 N zinc acetate solution. Either use a commercial solution or dissolve 44 grams of zinc acetate dihydrate in water and dilute to 100 milliliter (mL).
- Pipettes and pipette bulbs for dispensing preservatives
- Containers (usually gallon ziplock bags) for ice
- Filtration apparatus, if required. An electric vacuum pump connected to disposable (single use) sterile filter systems with 0.45 micron filters is the most common type.

## **2.0 PROCEDURES**

All samples should be preserved at low temperatures and kept from light during transport to the laboratory. Appropriate chemical preservation should be performed in the field for various analytical parameters at the time of sampling. This is particularly important for water samples. The site-specific sampling plan should detail which of the procedures outlined below will be implemented.

When selecting preservation techniques for a specific monitoring program, the sampler should refer to the guidance provided in the documentation of the analytical methods such as those listed in the reference section of this SOP. In some instances, the optimal method for sample preservation may be inappropriate because of restrictions placed by shippers on transporting certain chemicals. When shipping restrictions prevent the use of certain reagents for sample preservation, the most appropriate and permissible technique should be used. Frequently, this will require refrigeration of the sample during transit.

In general, all environmental water samples should be placed in an insulated ice chest and iced to lower the sample water temperatures to 4 °C immediately after sample collection. Hazardous samples should not be preserved in any way, including refrigeration; see SOP No. 019, "Packaging and Shipping Samples."

### **2.1 PRESERVATION OF SOLID, SOIL, AND AIR SAMPLES.**

Preservation of solid, soil, and air samples largely depends both on what analyses are to be requested and on what the particular laboratory or program to be used requires. Sampling teams should consider the preservation requirements when preparing a quality assurance project plan before proceeding to the field.

Lacking specific guidance, however, the following general guidance should be followed. Samples of soil and other solids should be preserved by sealing them in sampling container and by storing them

on ice or by refrigerating them to 4 °C. Samples should be sent for analysis as soon as possible. Samples of air are not to be preserved but are to be analyzed as soon as possible.

## **2.2 PRESERVATION OF WATER SAMPLES**

Preservation of water samples depends largely on what analyses are being requested and on what the laboratory or laboratory program to be used requires. The following sections, however, detail typical requirements of such laboratories and programs.

### **2.2.1 Preservation Procedures for Metals in Water**

Before collecting the water sample, determine what type of data is needed, such as dissolved, suspended, total, or total recoverable metals. For container preference, maximum holding times, and sample preservation at time of collection, see Table 1.

#### **Dissolved Metals**

When the samples are to be analyzed for dissolved metals, do the following:

- Filter each sample through a 0.45 micron membrane as soon as practical after collection. Glass or plastic filtering apparatus and plain, non-grid marked membrane filters are recommended to avoid possible contamination.
- Use the first 50 to 100 mL of sample to rinse the filter flask. Discard this portion and collect the required volume of filtrate.
- Acidify the filtrate with 1:1 HNO<sub>3</sub> to a pH of less than 2 as soon as possible. Normally, 2 mL of 1:1 acid per liter should be sufficient to preserve the sample.
- If hexavalent chromium is to be included in the analytical scheme, a portion of the filtrate should be transferred to a separate container before acidification. Analyze this portion within the holding time requirements noted in Table 1 at the end of this SOP.
- Analyses performed on these samples will be reported as "dissolved" concentrations.

### **Total Metals**

When samples are to be analyzed for total metals, acidify each sample at the time of collection with 2 mL of 1:1 HNO<sub>3</sub>, per liter of sample. This will lower each sample's pH to less than 2. Do not filter the sample.

#### **2.2.2 Preservation Procedures for Cyanide in Water**

When samples are to be analyzed for cyanide, do the following:

- Add 2 mL of 10 N NaOH per liter of sample to increase the pH to greater than 12.
- Test for oxidizing agents that decompose most cyanides. Do this by placing a drop of the sample on potassium iodide-starch test paper (KI starch paper); a blue color indicates that oxidizing agents are present. If oxidizing agents are present treatment is needed. Add ascorbic acid to the sample container, a few crystals at a time, until a drop of sample produces no color on the KI starch paper. Then add an additional 0.6 gram of ascorbic acid for each liter of sample volume.
- Analyze the samples within the prescribed holding time after collection.

#### **2.3.3 Preservation Procedures for Nitrogen in Water**

Procedures for nitrogen species vary considerably between desired tests. The following three sections detail those procedures.



### **Kjeldahl Nitrogen Total**

When samples are to be tested for nitrogen total, do the following:

- Preserve samples by adding 2 mL of concentrated  $\text{H}_2\text{SO}_4$  per liter of sample which should lower the pH to less than 2. Store the sample at 4 °C.
- Even when preserved in this manner, conversion of organic nitrogen to ammonia may occur. Analyze the preserved samples as soon as possible.

### **Nitrate Plus Nitrite**

When samples are to be tested for nitrate plus nitrite, then do the following:

- If analysis can be completed within 24 hours, preserve the sample by refrigeration at 4 °C.
- When samples must be stored for more than 24 hours, preserve samples with 2 mL of  $\text{H}_2\text{SO}_4$  per liter of sample volume which should lower the pH to less than 2; then refrigerate samples at 4 °C.
- Do not preserve those samples that will be analyzed using a reduction column and mercuric chloride.

### **Nitrite**

When samples are to be analyzed for nitrite, follow the procedure below:

- Analyze samples as soon as possible.
- If a sample must be stored for 24 to 48 hours, refrigerate it at 4 °C.

#### **2.2.4 Preservation Procedure For Dissolved Oxygen (Procedure)**

The following is the procedure for preserving samples to be analyzed for dissolved oxygen using the Winkler Method.

- Collect each sample in a 300-mL biological oxygen demand BOD incubation bottle. Take special care to avoid entrainment of atmospheric oxygen or loss of dissolved oxygen. At time of sampling, record the sample temperature.
- When samples are collected from depths of less than 5 feet, use an APHA-type sampler. Use a Kemmerer-type sampler for samples collected from depths of greater than 5 feet. (See APHA (1989) for details)).
- When a Kemmerer sampler is used, fill the BOD sample bottle until it overflows for approximately 10 seconds. Insert the outlet tube of the Kemmerer into the bottom of the BOD bottle. Take care to prevent turbulence and the formation of bubbles when filling the bottle.
- If samples must be preserved, immediately add 0.7 mL of  $\text{H}_2\text{SO}_4$  and 1 mL of sodium azide solution to the sample bottle and mix. As soon as practical, begin the assay by adding 2 mL  $\text{MnSO}_4$  solution and 3 mL alkali-iodide solution and mix. After the precipitate has settled, add 2 mL  $\text{H}_2\text{SO}_4$  and mix to dissolve the precipitate. Complete analysis within 4 to 8 hours after sampling.

#### **2.2.5 Preservation Procedures for Phosphorus in Water**

When preserving water samples to be analyzed for phosphorus, do the following:

- If benthic deposits are present in the area being sampled, take care not to include these deposits.
- If the analysis cannot be performed the same day of collection, preserve the sample by adding 2 mL of concentrated  $\text{H}_2\text{SO}_4$  per liter which will lower the pH to less than 2.
- Refrigerate at 4 °C.

#### 2.2.6 Preservation Procedures for Sulphide in Water

The following procedure is used to preserve water samples to be analyzed for sulphide:

- Take samples with a minimum of aeration. Sulfide may be volatilized by aeration, and any oxygen inadvertently added to the sample may convert the sulfide to an unmeasurable form.
- If the sample is not preserved with zinc acetate and NaOH as given in Table 1, the analysis must be performed immediately. Similarly, the measurement of dissolved sulfides also must be performed immediately.

#### 2.2.7 Preservation Procedures for Organics in Water

These procedures vary with the type of assay desired.

##### Chemical Oxygen Demand

If the assay is for chemical oxygen demand, then the following procedure is used:

- Collect samples in glass bottles with Teflon-lined caps.
- Test biologically active samples as soon as possible.
- Collecting composite samples and dividing samples into separate aliquots are generally not possible because some of the sample is lost on equipment and because of imperfect mixing.
- Preserve samples with sulfuric acid to a pH of less than 2.
- Refrigerate at 4 °C.

### Oil, Grease, and Petroleum Hydrocarbons

If the assay is oil, grease, or other petroleum hydrocarbons, then do the following:

- Collect 1 liter of representative sample in a glass bottle.
- A delay between sampling and analysis of greater than 4 hours requires sample preservation. To preserve the sample, add  $H_2SO_4$  until the pH is less than 2. A delay greater than 48 hours also requires refrigeration at 4 °C.

### Organic Carbon

If the assay is organic carbon, then do the following:

- Use glass bottles for sampling and storage of samples.
- Store samples at 4 °C.
- Protect samples from sunlight and atmospheric oxygen.
- In instances where analysis cannot be performed within 2 hours of sampling, acidify samples to a pH of less than 2 with HCl or  $H_2SO_4$ .

### Volatile Organics

If the assay is volatile organics, then do the following:

- Add 3 or 4 drops of concentrated hydrochloric acid to an empty 40-mL vial.
- Fill the sample vial carefully to avoid bubbles. At least two vials should be collected for each sample.
- Cap the vials carefully using caps with Teflon®-lined septa.
- Invert each vial and check for bubbles. If bubbles are present, unscrew the cap, add more water, and recap.
- Refrigerate at 4 °C.

**TABLE 1**  
**REQUIRED CONTAINER TYPES,**  
**PRESERVATION TECHNIQUES, AND HOLDING TIMES**  
**FOR WATER SAMPLES**

Name	Container Type <sup>a</sup> (plastic or glass)	Preservation	Maximum Holding Time
<b>Bacterial Tests</b>			
Coliform, fecal and total	P, G	Cool, 4 °C, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	6 hours
Fecal streptococci	P, G	Cool, 4 °C, 0.008% $\text{Na}_2\text{S}_2\text{O}_3$	6 hours
<b>Inorganic Tests</b>			
Acidity	P, G	Cool, 4 °C	14 days
Alkalinity	P, G	Cool, 4 °C	14 days
Ammonia	P, G	Cool, 4 °C, $\text{H}_2\text{SO}_4$ to pH < 2	28 days
Biochemical oxygen demand	P, G	Cool, 4 °C	48 hours
Bromide	P, G	None required	28 days
Biochemical oxygen demand, carbonaceous	P, G	Cool, 4 °C	48 hours
Chemical oxygen demand	P, G	Cool, 4 °C, $\text{H}_2\text{SO}_4$ to pH < 2	28 days
Chloride	P, G	None required	28 days
Chlorine, total residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4 °C	48 hours
Cyanide, total and amenable to chlorination	P, G	Cool, 4 °C, NaOH to pH > 12, 0.6g ascorbic acid	14 days
Fluoride	P	None required	28 days
Hardness	P, G	$\text{HNO}_3$ to pH < 2, $\text{H}_2\text{SO}_4$ to pH < 2	6 months
Hydrogen ion (pH)	P, G	None required	Analyze immediately
Kjeldahl and organic nitrogen	F, G	Cool, 4 °C, $\text{H}_2\text{SO}_4$ to pH < 2	28 days

**TABLE 1 (Continued)**  
**REQUIRED CONTAINER TYPES,**  
**PRESERVATION TECHNIQUES, AND HOLDING TIMES**  
**FOR WATER SAMPLES**

Name	Container Type* (plastic or glass)	Preservation	Maximum Holding Time
<b>Metals</b>			
Nitrate	P, G	Cool, 4 °C	48 hours
Nitrate-nitrite	P, G	Cool, 4 °C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
Nitrite	P, G	Cool, 4 °C	48 hours
Oil and grease	G	Cool, 4 °C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
Organic carbon	P, G	Cool, 4 °C, HCl or H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
<b>Inorganic Tests</b>			
Orthophosphate	P, G	Filter immediately, cool, 4 °C	48 hours
Oxygen dissolved probe	G only	None required	Analyze immediately
Winkler	G only	Fix on site and store in dark	8 hours
Phenols	G only	Cool, 4 °C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
Phosphorus (elemental)	G	Cool, 4 °C	48 hours
Phosphorus, total	P, G	Cool, 4 °C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
Residue, total	P, G	Cool, 4 °C	7 days
Residue, Filterable	P, G	Cool, 4 °C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4 °C	7 days
Residue, settleable	P, G	Cool, 4 °C	48 hours
Residue, volatile	P, G	Cool, 4 °C	7 days
Silica	P	Cool, 4 °C	28 days
Specific conductance	P, G	Cool, 4 °C	28 days
Sulfate	P, G	Cool, 4 °C	28 days

TABLE 1 (Continued)

REQUIRED CONTAINER TYPES,  
PRESERVATION TECHNIQUES, AND HOLDING TIMES  
FOR WATER SAMPLES

Name	Container Type* (plastic or glass)	Preservation	Maximum Holding Time
Sulfide	P, G	Cool, 4 °C, add zinc acetate plus NaOH to pH > 9	7 days
Sulfite	P, G	None required	Analyze immediately
Surfactants	P, G	Cool, 4 °C	48 hours
Temperature	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4 °C	48 hours
<b>Metals</b>			
Chromium VI	P, G	Cool, 4 °C	24 hours
Mercury	P, G	HNO <sub>3</sub> to pH < 2	28 days
Metals, except chromium VI and mercury	P, G	HNO <sub>3</sub> to pH < 2	6 months
<b>Organic Tests</b>			
Purgeable halocarbons	G, Teflon®-lined septum	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> HCL to pH < 2	14 days
Purgeable aromatic hydrocarbons	G, Teflon®-lined septum	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> HCl to pH < 2	14 days
Acrolein and acrylonitrile	G, Teflon®-lined septum	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> Adjust pH to 4-5	14 days
Phenols	G, Teflon®-lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	7 days until extraction, 40 days after extraction
Benzidines	G, Teflon®-lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	7 days until extraction

TABLE 1 (Continued)

**REQUIRED CONTAINER TYPES,  
PRESERVATION TECHNIQUES, AND HOLDING TIMES  
FOR WATER SAMPLES**

Name	Container Type <sup>a</sup> (plastic or glass)	Preservation	Maximum Holding Time
Phthalate esters	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C	7 days until extraction 40 days after extraction
Nitrosamines	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, store in dark, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	40 days after extraction
PCBs, acrylonitrile	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C	40 days after extraction
Nitroaromatics and isophorone	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> store in dark	40 days after extraction
Polynuclear aromatic hydrocarbons	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> store in dark	40 days after extraction
Haloethers	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	40 days after extraction
Chlorinated hydrocarbons	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C	40 days after extraction
TCDD	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, 0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	40 days after extraction
Total organic halogens	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, H <sub>2</sub> SO <sub>4</sub> to pH < 2	7 days
<b>Pesticide Tests</b>			
Pesticides	G, Teflon <sup>®</sup> -lined cap	Cool, 4 °C, pH 5-9	40 days after extraction
<b>Radiological Tests</b>			
Alpha, beta and radium	P, G	HNO <sub>3</sub> to pH < 2	6 months

Notes:

<sup>a</sup> Polyethylene (P) or Glass (G).



**TABLE 2**  
**REQUIRED CONTAINER TYPES,**  
**PRESERVATION TECHNIQUES, AND HOLDING TIMES**

Name	Container Type	Preservation	Maximum Holding Time
<b>Semivolatile Organics</b>			
Concentrated Waste Samples	8-oz widemouth glass jar with Teflon® liner	None	14 days
Liquid Samples: No Residual Chlorine Present	1-gal. or 2 1/2-gal. amber glass jar with Teflon® liner	Cool, 4 °C	Samples must be extracted within 7 days and extracts analyzed within 40 days
Liquid Samples: Residual Chlorine Present	1-gal. or 2 1/2-gal. amber glass jar with Teflon® liner	Add 3mL 10% sodium thiosulfate per gallon, Cool, 4°C	Samples must be extracted within 7 days and extracts analyzed within 49 days
Soil/Sediments and Sludges	8-oz widemouth glass jar with Teflon® liner	Cool, 4 °C	14 days
<b>Volatile Organics</b>			
Concentrated Waste Samples	8-oz widemouth glass jar with Teflon® liner	None	14 days
Liquid Samples: No Residual Chlorine Present	Two 40-mL vials with Teflon® lined septum caps	4 drops conc. HCl, Cool, 4 °C	14 days
Liquid Samples: Residual Chlorine Present	Two 40-mL vials with Teflon® lined septum caps	Collect sample in a 4 oz soil VOA container which has been prepreserved with 4 drops of 10% sodium thiosulfate. Gently mix sample and transfer to a 40-mL VOA vial that been prepreserved with 4 drops conc. HCl, Cool to 4 °C	14 days

TABLE 2 (Continued)

REQUIRED CONTAINER TYPES,  
PRESERVATION TECHNIQUES, AND HOLDING TIMES

Name	Container Type	Preservation	Maximum Holding Time
Liquid Samples: Acrolein and Acrylonitrile	Two 40-mL vials with Teflon® lined septum caps	Adjust to pH 4-5, Cool, 4 °C	14 days
Soil/Sediments and Sludges	4-oz (120-mL) widemouth glass jar with Teflon® liner	Cool, 4 °C	14 days
<b>Metals</b>			
Concentrated Waste Sample	8-oz. widemouth glass with Teflon® line	None	None
Liquid Samples	1-liter cubitainer	Adjust pH to <2 with HNO <sub>3</sub> , Cool 4°C	6 months
Soil/Sediment Studies	8-oz. widemouth glass jar	None	None

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**SAMPLE COLLECTION CONTAINER REQUIREMENTS**

**SOP NO. 017**

**REVISION NO. 1**

Approved by:

Kathleen Homer  
Quality Assurance Officer

5/21/93  
Date

## **1.0 BACKGROUND**

This standard operating procedure (SOP) has been prepared in accordance with the U.S. Environmental Protection Agency/National Enforcement Investigation Center (EPA/NEIC) *User's Guide to the Contract Laboratory Program* (CLP) and other references listed below. This SOP has been developed as guidance to selecting the proper containers for use in collecting environmental samples for Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) projects as well as projects for state and local agencies and private clients.

### **1.1 PURPOSE**

The purpose of this SOP is to present the procedure for selection of appropriate sample containers for samples collected for organic and inorganic analyses.

### **1.2 SCOPE**

The procedure presented in this SOP must be followed when environmental sample are collected for projects governed by the quality assurance/quality control requirements of the EPA or by state and local agencies. The guidance outlined below is acceptable for the routine analytical services (RAS) and special analytical services (SAS) provided by the EPA CLP.

### **1.3 DEFINITIONS**

Definitions are provided in the text as needed.

## 1.4 REFERENCES

Environmental Protection Agency (EPA). 1987. *A Compendium of Superfund Field Operations Methods*. Office of Emergency and Remedial Response. Washington, D.C. OSWER Directive 9355.0-14 EPA/540/P-87/001. December.

EPA. 1988. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response. Washington, D.C. OSWER Directive No. 9240.0-1.

EPA. 1990. "Standard Operating Procedure 2130.4A: Sample Containers, EPA Region 7." *Environmental Services Division Operations and Quality Assurance Manual*.

*Federal Register*. Vol. 49. No. 209.

## 1.5 REQUIREMENTS AND RESOURCES

A source of precleaned sample containers which have been analyzed to provide quality assurance is required for the proper containment of environmental samples. A copy of all documentation that verifies the suitability of the containers for the required analyses should be maintained in the project file.

## 2.0 PROCEDURE

Sample containers should be selected in accordance with the requirements listed in Table 1 and illustrated in Figures 1 through 4 at the end of this document. Container requirements are provided for organic and inorganic analyses as well as for dioxin and other high hazard samples.

Based on the sample matrices and analyses as defined in the project-specific sampling and analysis plan (SAP) or quality assurance project plan (QAPjP), the appropriate environmental sample containers may be chosen by referring to Table 1. This table lists the containers required, preservation techniques, and sample holding time restrictions. The containers specified in Figures 1 through 4 should be adequate for most RAS requests. Be sure to contact the EPA sample coordinator

or private laboratory if you are not sure of the container requirements or if modified RAS or SAS procedures are requested.

### 3.0 COMMON PROBLEMS

One of the most common problems encountered with the EPA CLP are region-specific variations in the sample container requirements. In most EPA regions, soil samples for volatile organic analysis may be collected in 4-ounce screw top bottles. Conversely, in EPA Region 7, soils for volatile organic analysis must be collected in 40-mL vials equipped with Teflon®-lined septa. If you are not sure of regional or project-specific variations, contact the laboratory coordinator or project manager.

In general, for water analyses, glass containers are used for organic analyses and plastic containers are used for metals analyses. Glass containers are used especially for semivolatile organic analyses of water because plasticizers (phthalates) may be leached from plastic containers and interfere with the organic analyses. Plastic is used instead of glass for metals analysis of water because metals will sorb to active sites on the glass surface. This could produce anomalously low, or false negative, results for metals in water.

Overnight shipment or quick delivery is a must to meet the holding time requirements for volatile organic analyses. Also, be aware of potentially contaminated preservatives such as nitric acid or sodium hydroxide. Always use fresh high-quality preservative reagents.

Sample duplicates, matrix spikes, and matrix spike duplicates are usually required on five to ten percent of the samples collected. In general, additional sample volume is required for these quality control samples. Be sure to obtain additional sample containers for the required quality control samples.

Biota samples may require special packaging and preservation procedures. For example, fish samples are usually wrapped in aluminum foil and shipped in coolers on dry ice. Shipping with dry ice

requires special labeling and handling procedures. Contact the sample coordinator, project manager, and shipper for these special biota sample requirements.

**TABLE 1**  
**REQUIRED CONTAINER TYPES,**  
**PRESERVATION TECHNIQUES, AND HOLDING TIMES**

Name	Container Type	Preservation	Maximum Holding Time
<b>Semivolatile Organics</b>			
Concentrated Waste Samples	8-oz widemouth glass jar with Teflon® liner	None	14 days
Liquid Samples: No Residual Chlorine Present	1-gal. or 2 1/2-gal. amber glass jar with Teflon® liner	Cool, 4 °C	Samples must be extracted within 7 days and extracts analyzed within 40 days
Liquid Samples: Residual Chlorine Present	1-gal. or 2 1/2-gal. amber glass jar with Teflon® liner	Add 3mL 10% sodium thiosulfate per gallon, Cool, 4°C	Samples must be extracted within 7 days and extracts analyzed within 49 days
Soil/Sediments and Sludges	8-oz widemouth glass jar with Teflon® liner	Cool, 4 °C	14 days
<b>Volatile Organics</b>			
Concentrated Waste Samples	8-oz widemouth glass jar with Teflon® liner	None	14 days
Liquid Samples: No Residual Chlorine Present	Two 40-mL vials with Teflon® lined septum caps	4 drops conc. HCl, Cool, 4 °C	14 days
Liquid Samples: Residual Chlorine Present	Two 40-mL vials with Teflon® lined septum caps	Collect sample in a 4 oz soil VOA container which has been prepreserved with 4 drops of 10% sodium thiosulfate. Gently mix sample and transfer to a 40-mL VOA vial that been prepreserved with 4 drops conc. HCl, Cool to 4 °C	14 days

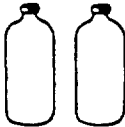




TABLE 1 (Continued)

REQUIRED CONTAINER TYPES,  
PRESERVATION TECHNIQUES, AND HOLDING TIMES

Name	Container Type	Preservation	Maximum Holding Time
Liquid Samples: Acrolein and Acrylonitrile	Two 40-mL vials with Teflon® lined septum caps	Adjust to pH 4-5, Cool, 4 °C	14 days
Soil/Sediments and Sludges	4-oz (120-mL) widemouth glass jar with Teflon® liner	Cool, 4 °C	14 days
<b>Metals</b>			
Concentrated Waste Sample	8-oz. widemouth glass with Teflon® line	None	None
Liquid Samples	1-liter cubitainer	Adjust pH to <2 with HNO <sub>3</sub> , Cool 4°C	6 months
Soil/Sediment Studios	8-oz. widemouth glass jar	None	None





**FIGURE 1**  
**ORGANIC SAMPLE COLLECTION**  
**Volume Requirements**



WATER SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
2,3,7,8-TCDD ANALYSIS (MULTI-CONCENTRATION)	2 LITERS		2 x 1-LITER AMBER GLASS BOTTLES
SOIL/SEDIMENT SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
2,3,7,8-TCDD ANALYSIS (MULTI-CONCENTRATION)	4 OZ.		1 x 4-OZ. WIDE-MOUTH GLASS JAR
			OR 1 x 8-OZ. WIDE-MOUTH GLASS JAR

\*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT



**FIGURE 2**  
**INORGANIC SAMPLE COLLECTION**  
**Volume Requirements**

WATER SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
METALS ANALYSIS (LOW LEVEL)	1 LITER		1 x 1-LITER POLYETHYLENE BOTTLE
METALS ANALYSIS (MEDIUM LEVEL*)	16 OZ.		1 x 16-OZ. WIDE-MOUTH GLASS JAR
CYANIDE (CN <sup>-</sup> ) ANALYSIS (LOW LEVEL)	1 LITER		1 x 1-LITER POLYETHYLENE BOTTLE
CYANIDE (CN <sup>-</sup> ) ANALYSIS (MEDIUM LEVEL*)	16 OZ.		1 x 16-OZ. WIDE-MOUTH GLASS JAR

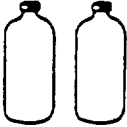


SOIL/SEDIMENT SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
METALS AND CYANIDE (CN <sup>-</sup> ) ANALYSIS (LOW OR MEDIUM LEVEL*)	8 OZ.		1 x 8-OZ. WIDE-MOUTH GLASS JAR
			OR
			2 x 4-OZ. WIDE-MOUTH GLASS JARS

\*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT



**FIGURE 3**  
**DIOXIN SAMPLE COLLECTION**


**Volume Requirements**

WATER SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
2,3,7,8-TCDD ANALYSIS (MULTI-CONCENTRATION)	2 LITERS		2 x 1-LITER AMBER GLASS BOTTLES
SOIL/SEDIMENT SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
2,3,7,8-TCDD ANALYSIS (MULTI-CONCENTRATION)	4 OZ.		1 x 4-OZ. WIDE-MOUTH GLASS JAR
			OR 1 x 8-OZ. WIDE-MOUTH GLASS JAR

\*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT



**FIGURE 4**  
**HIGH HAZARD SAMPLE COLLECTION**  
**Volume Requirements**

LIQUID OR SOLID SAMPLES	REQUIRED VOLUME		CONTAINER TYPE
ORGANIC AND INORGANIC ANALYSIS	6 OZ.		1 x 8-OZ. WIDE-MOUTH GLASS JAR

\*ALL MEDIUM LEVEL SAMPLES TO BE SEALED IN METAL PAINT CAN FOR SHIPMENT



**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**SAMPLE CUSTODY**

**SOP NO. 018**

**REVISION NO. 2**

Approved by:

Daniel Ashenberg  
Quality Assurance Officer

2/2/93  
Date

Date of Original Issue: 03/31/91

Title: Sample Custody

## **1.0 BACKGROUND**

In any sampling and analytical program, the integrity of a sample must be documented from its point of collection to its final disposition. The documentation of the possession and handling of samples is referred to as "chain of custody." The components of this chain, such as sample custody seals, traffic reports, field logbooks, chain-of-custody records, and sample identification tags, and the procedures for their use are described below.

### **1.1 PURPOSE**

This standard operating procedure (SOP) establishes the requirements and procedures for sample custody. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA)/National Enforcement Investigation Center (NEIC) User's Guide to the EPA Contract Laboratory Program (CLP). Sample custody and documentation procedures described in this SOP should be followed throughout all sample collection activities unless the procedures are revised by EPA. All revisions must be documented in the field logbook.

### **1.2 SCOPE**

This SOP applies to sample custody and the activities associated with it.

### **1.3 DEFINITIONS**

None.

Date of Original Issue: 03/31/91

Title: Sample Custody

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## **1.4 REFERENCES**

U.S. Environmental Protection Agency, 1988, User's Guide to the EPA Contract Laboratory Program. EPA Office of Emergency and Remedial Response, Washington, D.C.

## **1.5 REQUIREMENTS AND RESOURCES**

Numerous sample identification documents are used to control sample disposition and to maintain a chain-of-custody record for all samples collected. These documents include sample container labels, identification tags, custody seals, chain-of-custody records, and traffic report forms.

## **2.0 PROCEDURES**

The following subsections present detailed instructions for completing chain-of-custody documents, including sample container labels, sample identification tags, custody seals, chain-of-custody records, and traffic reports.

### **2.1 SAMPLE CONTAINER LABELS**

The sample container label is an adhesive label with designated areas to indicate the station location, date and time of sample collection, analysis requested, and preservative added. Before placing the sample material in the appropriate container, the sampler should complete the label with waterproof ink and affix the label to the container. When necessary, the sample label should be protected from water and solvents with clear tape.



Date of Original Issue: 03/31/91

Title: Sample Custody

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## 2.2 SAMPLE IDENTIFICATION TAGS

Sample identification tags (Figures 1 and 1A) provided by EPA are used to maintain control of laboratory samples. The PRC field team leader should distribute the tags to field team members. The EPA serial numbers should be recorded in the field notebook. Sample tags should be attached to all sample containers used. Unused tags should be returned to the field team leader. Each tag should be completed as follows:

- Space No. 1 should be completed with the case number provided by the CLP laboratory.
- Space No. 2 should be completed with the appropriate sample location number.
- Spaces No. 3A and 3B should be completed with the time and date of sample collection, respectively.
- Space No. 4 should designate whether the sample is grab or composite.
- Space No. 5 should be completed with the sampling location.
- Space No. 6 should contain the signature(s) of the sampler(s).
- Space No. 7 should designate whether a preservative has been added to the sample. If a preservative has been added to the sample, the name of the preservative should be written in the space marked "Remarks."
- Space No. 8 should designate all appropriate analyses to be performed by the laboratory.
- The remarks section should include the traffic report sample number and bottle lot number.

FIGURE 1

SAMPLE TAG



☆ GPO 808-467

Designator: 324	Temp. 3A	Identification 3B	Station No. 2	Project Code 1-	Station Location 5	Preservative: Yes <input type="checkbox"/> , No <input type="checkbox"/>
						ANALYSES 8
						BOD Anions
						Solids (max/min/avg)
						COD, TOC, Nutrients
						Phenolics
						Mercury
						Metals
						Cyanide
						Oil and Grease
						Organics GC/MS
						Priority Pollutants
						Volatile Organics
						Pesticides
						Mutagenicity
						Bacteriology
						Remarks:
						Log No. Lab Sample No.
						3- 158232


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FIGURE 1A

SAMPLE TAG

Project Code W63910.C01 21.5M10.0		Station No. HW 26 SS - 11(6)	Month/Day/Year 5-28-93	Time 1007	Background Comp. <input checked="" type="checkbox"/> Cont. <input checked="" type="checkbox"/>
Sample Location Monitoring well 42L Split Spoon # 11		Sampler (Signature) Jane Doe		Preservative: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Tag No. H0502		Lab Sample No.			
ANALYSES					
BOD		Antions			
Solids		Pb (ppm) (TDS) (SS)			
COD, TOC, Nutrients					
Phenolics					
Mercury					
Metals					
Cyanide					
Oil and Grease					
Organics GC/MS				X	
Priority Pollutants				X	
Volatile Organics				X	
Pesticides				X	
Mutagenicity					
Bacteriology					
Remarks: CASE 1746 IR # H E 0637 Bottle Lot # 63120					



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## 2.3 CUSTODY SEALS



A custody seal is an adhesive label. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packed for shipping. When samples are shipped to an EPA regional CLP laboratory, they must be placed in containers sealed with EPA custody seals. Custody seals differ among EPA regions; three examples are shown on Figure 2. Some custody seals are serially numbered; others are unnumbered and only provide evidence that the sample has not been tampered with. Two seals must be signed and placed on each shipping container or cooler: one at the front and one at the back as shown on Figure 3. Clear tape should be placed over the seals to help ensure that they are not accidentally broken during shipment.


## 2.4 CHAIN-OF-CUSTODY RECORDS

All sample shipments should be accompanied by a chain-of-custody record (see Figures 4 and 4A) that identifies their contents. The original record should accompany the shipment, and the yellow copy should be given to the PRC field team leader. Because field sample data may be the object of litigation, the custody of the samples must be documented from collection through laboratory analysis. A chain-of-custody record accompanies the samples to identify each transfer of custody. Individuals relinquishing and receiving samples should sign, date, and note the time of transfer on the record. This record should be used to document sample custody transfer from the sampler to another PRC team member, to a shipper, or to the regional or CLP laboratory. All field sampling personnel should sign the form as field samplers. The first individual to relinquish custody must sign the chain-of-custody record as a field sampler.

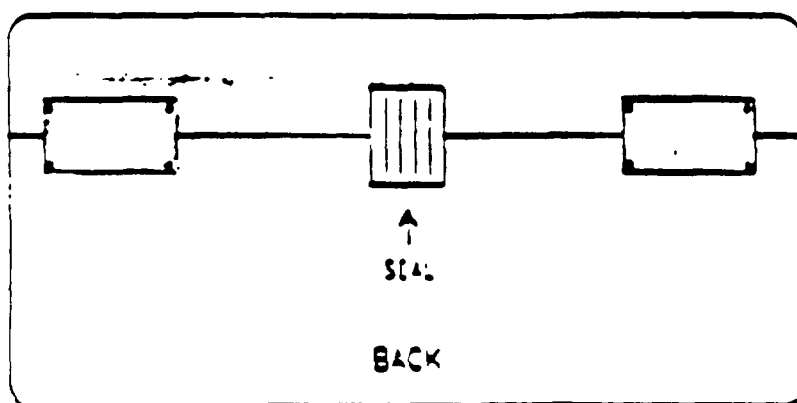
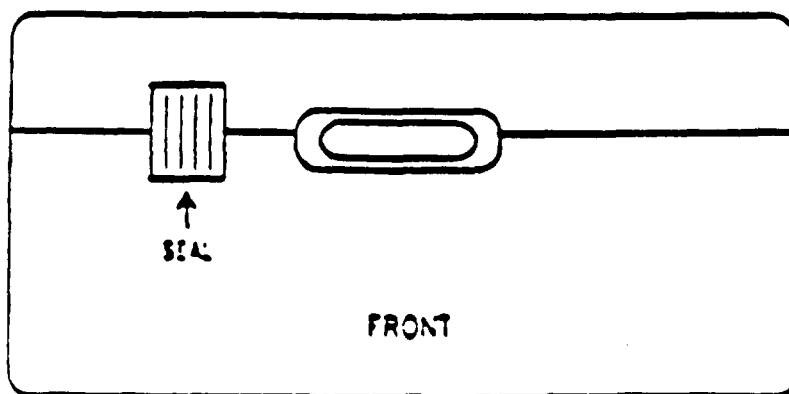
FIGURE 2  
CUSTODY SEALS

ENVIRONMENTAL PROTECTION AGENCY	SAMPLE NO.	EPA Form 7100-2107-701
	SIGNATURE	
	PRINT NAME AND TITLE (Inspector, Analyst or Technician)	

CUSTODY SEAL			CUSTODY SEAL
			Date
			Signature

 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY OFFICIAL SAMPLE SEAL	SAMPLE NO.	DATE	EPA Form 7100-2107-701
	SIGNATURE		
	PRINT NAME AND TITLE (Inspector, Analyst or Technician)		

**FIGURE 3**  
**PLACEMENT OF SECURITY SEALS ON**  
**SHIPPING CONTAINERS AND COOLERS**



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**FIGURE 4**  
**CHAIN-OF-CUSTODY RECORD**

[illegible]

PRC Environmental Management, Inc.  
Standard Operating Procedure

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FIGURE 4A  
CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY RECORD													
PROJ. NO. 12-2456		PROJECT NAME # 0123				NO. OF CONTAINERS	<div style="display: flex; justify-content: space-around;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Total Metals</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Cyanide</div> </div>					REMARKS	
SAMPLERS: <i>John Samples</i>													
STA. NO.	DATE	TIME			STATION LOCATION						ITA	Tag #	
001	9/26	8:00		X	LOC-ST-010	2	X	X			ME1701	5-102501	
											-	5-102502	
002	9/26	11:00		X	LOC-ST-011	2	X	X			ME1702	5-102503	
											-	5-102504	
003	9/26	14:00		X	LOC-ST-012	2	X	X			ME1703	5-102505	
											-	5-102506	
004	9/26	17:00		X	LOC-ST-013	2	X	X			ME1704	5-102507	
											-	5-102508	
005	9/26	18:00		X	LOC-ST-014	2	X	X			ME1705	5-102509	
											-	5-102510	
Relinquished by: <i>John Samples</i>		Date / Time 9/26 18:00		Received by: <i>Federal Express</i>		Relinquished by: <i>John Samples</i>		Date / Time		Received by: <i>John Samples</i>			
Relinquished by: <i>John Samples</i>		Date / Time		Received by: <i>John Samples</i>		Relinquished by: <i>John Samples</i>		Date / Time		Received by: <i>John Samples</i>			
Relinquished by: <i>John Samples</i>		Date / Time		Received for Laboratory by: <i>Mary Sunshine</i>		Date / Time 9/27 10:00		Remarks Case # 1000 Fed. Ex. # 123456789 Custody Seals # 01122 : 01123					



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Samples should be packaged properly for shipment (as detailed in SOP No. 019) and should be dispatched to the appropriate laboratory for analysis. A separate chain-of-custody record should accompany each shipment.

Whenever samples are split with another party, it should be noted in the remarks section of the chain-of-custody record.

The procedure for completing the chain-of-custody record is as follows:

1. Space 1 should list the case number provided by the laboratory.
2. Space 2 should list the initials of the site name.
3. Space 3 should contain the signature(s) of the sampler(s).
4. Column 4 should list the sampling location number for each sample shipped.
5. Columns 5A and 5B should list the date and time each sample was taken.
6. Columns 6A and 6B should indicate whether each sample shipped was a composite or grab sample.
7. Column 7 should list the sampling location for each sample.
8. Column 8 should list the total number of sample containers for each sample shipped.
9. Columns 9A through 9F should indicate the type of sample shipped.
10. Column 10 should list the traffic report sample number and the sample identification tag number for each sample container shipped.
11. Space 11 should contain the signature of the sample collector.
12. Spaces 12A and 12B should list the date and time the samples were relinquished by the sample collector.

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13. Space 13 should list the carrier's name and the airbill number.
14. The sample cooler should be properly packed for shipping.
15. The completed original, white copy of the chain-of-custody record, should be shipped inside the cooler, as detailed in SOP No. 019. The yellow copy should be retained by the PRC field team leader and should be placed in the project file.

If sent by mail, the package should be registered and a return receipt should be requested. If sent by common carrier, a bill of lading should be used. Air freight shipments should be sent collect. Freight bills, postal service receipts, and bills of lading should be retained as part of the chain-of-custody documentation (see Figure 5). The carrier will provide the forms and instructions for filling them out.

## **2.5 TRAFFIC REPORTS**

Different traffic report forms are used for each of the major types of assay under the CLP. These include organic, inorganic, dioxin, and special analytical service (SAS).

### **2.5.1 Organic and Inorganic Traffic Reports**

For samples shipped to CLP laboratories for organic and inorganic analysis, field investigation personnel should use Organic Traffic Report forms (see Figures 6 and 6A) and Inorganic Traffic Report forms (see Figures 7 and 7A) provided by EPA.

Traffic reports are preprinted forms provided by EPA's Sample Management Office (SMO). These forms are part of EPA's sample tracking system and are used to trace shipment of samples for CLP laboratory analysis.

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FIGURE 5  
AIRBILL

23 924 6725343811

1246-2717-6

303-295-1101

6725343811

PRC ENVIRONMENTAL MGMT INC

1099 18TH STE 1900

DENVER CO 80202

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

6725343811

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

TYPE OR FROM

ADDITIONAL LABELING INFORMATION

TRANSPORT DETAILS

THE SHIPPER IS OTHER THE

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

IF ACCEPTABLE FOR PASSENGER AIRCRAFT THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO RESEARCH MEDICAL DIAGNOSIS OR TREATMENT

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER

PLACE AND DATE

EMERGENCY TELEPHONE NUMBER

SIGNATURE OF SHIPPER

SEE WARNINGS ON BACK

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**FIGURE 6**  
**ORGANIC TRAFFIC REPORT**

[illegible]

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FIGURE 6A

## ORGANIC TRAFFIC REPORT

[illegible]

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**FIGURE 7**  
**INORGANIC TRAFFIC REPORT**

<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p style="font-size: small; margin: 0;">           United States Environmental Protection Agency            Central Laboratory Program    Sample Management Office            PO Box 910    Alexandria, VA 22304            (703) 412-9400    FTS 603-0400         </p> </div> <div style="width: 40%; text-align: center;"> <h2 style="margin: 0;">Inorganic Traffic Report</h2> <p style="margin: 0;">(For CLP Use Only)</p> </div> <div style="width: 30%; text-align: right;"> <p style="font-size: x-small; margin: 0;">Case Number</p> <p style="font-size: x-small; margin: 0;">SAR No. if applicable</p> </div> </div>									
1. Type of Activity (Check one)				2. Program number    Sampling Co.		3. Date Shipped    Arrival Number		4. Sample Description (Enter in Column A)	
<input type="checkbox"/> PAF <input type="checkbox"/> SW <input type="checkbox"/> CIB	<input type="checkbox"/> PFL <input type="checkbox"/> CSM <input type="checkbox"/> PA	<input type="checkbox"/> G <input type="checkbox"/> SW <input type="checkbox"/> CFW	<input type="checkbox"/> Other (Specify)	<input type="checkbox"/> Sampler (Flow)  1. Why?		Double volume required for mostly hydrophobic organic analytes.  Why method and high concentration analytes in past work.  See matrix for additional instructions.		1. Surface Water 2. Ground Water 3. Leachate 4. Precipitate 5. Soil/Sediment 6. Oil (SAG) 7. Waste (SAG) 8. Other (SAG) (Specify)	
Non-Scheduled Program				Site Name		City, State		Site Map #	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte		PC Analyte		PC Analyte		PC Analyte	
PC Analyte		PC Analyte</							

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# FIGURE 7A INORGANIC TRAFFIC REPORT

EPA United States Environmental Protection Agency Customer Laboratory Program - Sample Management Office PO Box 970 Alhambra, CA 91808 Tel 626-440-7400 FAX 626-440-7401										Inorganic Traffic Report (For CLP Use Only)		Case Number <b>10101</b>	SM No. if applicable
<b>1. Type of Activity (Check one)</b> <input type="checkbox"/> SW <input type="checkbox"/> GWM <input type="checkbox"/> L <input checked="" type="checkbox"/> S <input type="checkbox"/> OTH <input type="checkbox"/> SW <input type="checkbox"/> GWM <input type="checkbox"/> L <input type="checkbox"/> S <input type="checkbox"/> OTH <input type="checkbox"/> SW <input type="checkbox"/> GWM <input type="checkbox"/> L <input type="checkbox"/> S <input type="checkbox"/> OTH				<b>2. Sample Location</b> Sampling Co. <b>Acme Co.</b> Sample Point <b>Joan Sampler</b>		<b>3. Date Shipped</b> <b>11-4-88</b> <b>4. Batch Number</b> <b>0787650321</b>		<b>5. Sample Description (Refer to Column 4)</b> 1. Surface Water 2. Ground Water 3. Leachate 4. Filtrate 5. Solid/Liquid 6. Oil (SAG) 7. Waste (SAG) 8. Other (SAG) (Specify)					
<b>6. Ship To</b> <b>Analytical Lab</b> <b>100 Center Ave</b> <b>Anytown, CA 94368</b> <b>Attn: A. Patel</b>				<b>7. Ship Via</b> <b>Fed Ex</b>		<b>8. Remarks</b> Describe volume required for study up/downstream separate sample Ship medium and high concentration samples in same case. See column for additional instructions.							
<b>9. Site Name</b> <b>Drum Site</b> <b>City Name</b> <b>Green City, OR</b>				<b>10. State</b> <b>OR</b>									
CLP Sample Point Number	CLP Sample Point Name	CLP Sample Point Date	CLP Sample Point Volume	CLP Sample Point Matrix	CLP Sample Point Matrix	CLP Sample Point Matrix	CLP Sample Point Matrix	CLP Sample Point Matrix	CLP Sample Point Matrix	CLP Sample Point Matrix			
MJZ 900	1	L	X	X		LOC-1	11-4/0700	JA 321					
MJZ 901	1	L	X	X		LOC-2	11-4/0730	JA 322					
MJZ 902	1	L	X	X		LOC-3	11-4/0800	JA 323					
MJZ 903	1	L	X	X		LOC-4	11-4/0830	JA 324					
MJZ 904	1	L	X	X		LOC-5	11-4/0900	JA 325					
MJZ 905	1	L	X	X		LOC-6	11-4/0930	JA 326					
MJZ 906	1	L	X	X		LOC-7	11-4/0945	JA 327					
MJZ 907	1	L	X	X		LOC-8	11-4/1000	JA 328					
MJZ 908	1	L	X	X		LOC-9	11-4/1030	JA 329					
MJZ 909	1	L	X	X		LOC-10	11-4/1100	JA 330					
MJZ 910	1	L	X	X		LOC-11	11-4/1130	JA 331					
MJZ 911	1	L	X	X		LOC-12	11-4/1200	JA 332					
MJZ 912	1	L	X	X		LOC-13	11-4/1215	JA 333					
MJZ 913	1	L	X	X		LOC-14	11-4/1245	JA 334					
MJZ 914	1	L	X	X		LOC-15	11-4/1300	JA 335					
MJZ 915	1	L	X	X		LOC-16	11-4/1330	JA 336					
MJZ 916	1	L	X	X		LOC-17	11-4/1400	JA 337					
MJZ 917	1	L	X	X		LOC-18	11-4/1430	JA 338					
MJZ 918	1	L	X	X		LOC-19	11-4/1500	JA 339					
MJZ 920	1	L	X	X	MS / dup	LOC-20	11-4/1530	JA 340					

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The CLP generates unique sample numbers for each organic and inorganic sample. The unique sample numbers are printed on adhesive labels. The sampler is responsible for assigning this critical sample number correctly and transcribing it accurately onto the traffic report. The labels should be attached to each sample container prior to shipment. Organic sample number labels have the format XX123 and have 10 labels per strip: four for extractables, two for volatile organic analyses (VOA), and four extra blanks. Inorganic sample number labels have the format MXX123 and have seven labels per strip: two for total metals, two for cyanide, and three extra blanks (see Figure 8). The unique sample number must be used only once. Unused labels should be destroyed to prevent duplication of sample numbers.

Organic and inorganic traffic reports should be completed as follows:

- The spaces indicated by case number and Special Analytical Service (SAS) number (if applicable) in the top right corner should be completed with the appropriate numbers.
- Box 1 should indicate the type of sampling activity performed, the site name, the city, the state, and the site spill identification number.
- Box 2 should indicate the EPA region number, the name of the sampling company, and the name of the sampler.
- Box 3 should indicate the name of the sample custodian or CLP contact the sample is being shipped to, the name of the CLP laboratory, and its full address.
- Box 4 should indicate the date shipped, the carrier (abbreviated), and the airbill number.
- The CLP sample number from the printed sample labels should be listed in the far left column.



**FIGURE 8**  
**SAMPLE NUMBER LABELS**

**INORGANIC  
SAMPLE NUMBER  
LABELS**

MCCX 00	- Total Metals
MCCX 00	- Total Metals
MCCX 00	- Cyanide
MCCX 00	- Cyanide
MCCX 00	
MCCX 00	
MCCX 00	

**ORGANIC  
SAMPLE NUMBER  
LABELS**

CCX 20	- Extractable
CCX 20	- Extractable
CCX 20	- Extractable
CCX 20	- Extractable
CCX 20	- VOA
CCX 20	- VOA
CCX 20	
CCX 20	
CCX 20	
CCX 20	

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- Column A should indicate the appropriate sample description code from box 5. Blanks should be listed as item 3, "leachate." The word "blank" should be written in column D, the special handling section. Item 6, "oil," and item 7, "waste," should be used for Routine Analytical Service (RAS) PLUS SAS projects only. Do not ship oily samples or waste without making prior arrangements with the SMO.
- Column B should indicate the concentration of the sample shipped. For organic samples, low- or medium-concentration samples should be labeled "L," and high-concentration samples should be labeled "H." For inorganic samples, low-concentration samples should be labeled "L," medium-concentration samples should be labeled "M," and high-concentration samples should be labeled "H." Do not ship high concentrated samples without making prior arrangements with the SMO.
- Column C should indicate the appropriate analytical fractions requested under RAS for each sample.
- Column D should specify any special handling instructions for each sample. Blank samples should be identified in this space. When shipping RAS PLUS SAS samples, the sampler may code SAS parameters in the blank space and enter the codes in this column.
- Column E should indicate the sampling location.
- Column F should indicate the date and time of sample collection.
- Column G should indicate the corresponding CLP sample number for organic or inorganic analysis.

The original, white copy of the traffic report should be sent to SMO, P.O. Box 818, Alexandria, Virginia 22313. The phone number of the SMO is 703/557-2490. The pink copy should be retained by the PRC field team leader. The other white copy and the yellow copy should be sent with the shipment to the laboratory. The address of the laboratory will be provided by SMO.

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### **2.5.2 Dioxin Shipment Record**

The CLP Dioxin Shipment Record, a four-part, carbonless form, is used to document samples for the dioxin program (see Figures 9 and 9A). This form must be used for any dioxin samples. The dioxin shipment record provides documentation in each shipment of dioxin samples.

The form is similar to the traffic reports described above. To provide a permanent record of each sample collected, the sampler should record the appropriate case number and batch or shipment number on each shipment record form. The sampler should record the type of sampling activity, regional information, shipping information, and analysis laboratory. For each sample, the sampler should record the sample matrix and its description, such as soil or sediment field sample or solvent rinsate, by checking the appropriate box following each sample number.

After completing the dioxin shipment record, the sampler should send the bottom two copies to the laboratory with the sample shipment. Following sample shipment, the sampler should send the top copy to the SMO and retain the remaining copy as a file copy.

### **2.5.3 Special Analytical Service (SAS) Packing List**

For samples requiring special analytical services, samplers should use the SAS Packing List, a four-part carbonless form (see Figures 10 and 10A). The packing list provides space for up to 20 samples on one form. These samples should be numbered with the SAS number provided by the SMO. The SAS number, such as 2000E, should be followed by a hyphen and a progressive numerical designation starting with one, such as 2000E-1, 2000E-2, 2000E-3, and so on. If the sampling activity continues for several days and requires more than one list, sample numbers should not be repeated. EPA's regional office will verify with SMO that the packing list is appropriate for use in the situation.

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FIGURE 9  
CLP DIOXIN SHIPMENT FORM

[illegible]

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FIGURE 9A

CLP DIOXIN SHIPMENT FORM

[illegible][illegible]

DATE	TO	FROM	AMOUNT	REMARKS
1941	12/31	1940	100.00	Balance forward
1942	1/1	1941	100.00	Balance forward
1943	1/1	1942	100.00	Balance forward
1944	1/1	1943	100.00	Balance forward
1945	1/1	1944	100.00	Balance forward
1946	1/1	1945	100.00	Balance forward
1947	1/1	1946	100.00	Balance forward
1948	1/1	1947	100.00	Balance forward
1949	1/1	1948	100.00	Balance forward
1950	1/1	1949	100.00	Balance forward
1951	1/1	1950	100.00	Balance forward
1952	1/1	1951	100.00	Balance forward
1953	1/1	1952	100.00	Balance forward
1954	1/1	1953	100.00	Balance forward
1955	1/1	1954	100.00	Balance forward
1956	1/1	1955	100.00	Balance forward
1957	1/1	1956	100.00	Balance forward
1958	1/1	1957	100.00	Balance forward
1959	1/1	1958	100.00	Balance forward
1960	1/1	1959	100.00	Balance forward
1961	1/1	1960	100.00	Balance forward
1962	1/1	1961	100.00	Balance forward
1963	1/1	1962	100.00	Balance forward
1964	1/1	1963	100.00	Balance forward
1965	1/1	1964	100.00	Balance forward
1966	1/1	1965	100.00	Balance forward
1967	1/1	1966	100.00	Balance forward
1968	1/1	1967	100.00	Balance forward
1969	1/1	1968	100.00	Balance forward
1970	1/1	1969	100.00	Balance forward
1971	1/1	1970	100.00	Balance forward
1972	1/1	1971	100.00	Balance forward
1973	1/1	1972	100.00	Balance forward
1974	1/1	1973	100.00	Balance forward
1975	1/1	1974	100.00	Balance forward
1976	1/1	1975	100.00	Balance forward
1977	1/1	1976	100.00	Balance forward
1978	1/1	1977	100.00	Balance forward
1979	1/1	1978	100.00	Balance forward
1980	1/1	1979	100.00	Balance forward
1981	1/1	1980	100.00	Balance forward
1982	1/1	1981	100.00	Balance forward
1983	1/1	1982	100.00	Balance forward
1984	1/1	1983	100.00	Balance forward
1985	1/1	1984	100.00	Balance forward
1986	1/1	1985	100.00	Balance forward
1987	1/1	1986	100.00	Balance forward
1988	1/1	1987	100.00	Balance forward
1989	1/1	1988	100.00	Balance forward
1990	1/1	1989	100.00	Balance forward
1991	1/1	1990	100.00	Balance forward
1992	1/1	1991	100.00	Balance forward
1993	1/1	1992	100.00	Balance forward
1994	1/1	1993	100.00	Balance forward
1995	1/1	1994	100.00	Balance forward
1996	1/1	1995	100.00	Balance forward
1997	1/1	1996	100.00	Balance forward
1998	1/1	1997	100.00	Balance forward
1999	1/1	1998	100.00	Balance forward
2000	1/1	1999	100.00	Balance forward
2001	1/1	2000	100.00	Balance forward
2002	1/1	2001	100.00	Balance forward
2003	1/1	2002	100.00	Balance forward
2004	1/1	2003	100.00	Balance forward
2005	1/1	2004	100.00	Balance forward
2006	1/1	2005	100.00	Balance forward
2007	1/1	2006	100.00	Balance forward
2008	1/1	2007	100.00	Balance forward
2009	1/1	2008	100.00	Balance forward
2010	1/1	2009	100.00	Balance forward
2011	1/1	2010	100.00	Balance forward
2012	1/1	2011	100.00	Balance forward

FIGURE 10  
SPECIAL ANALYTICAL SERVICE PACKING LIST

U.S. ENVIRONMENTAL PROTECTION AGENCY  
CLP Sample Management Office  
P.O. Box 818 - Alexandria, Virginia 22313  
Phone: 703/557-2490 - FTS/557-2490

SAS Number

SPECIAL ANALYTICAL SERVICE  
PACKING LIST

Sampling Office	Sampling Date/Lab	Ship To	For Lab Use Only
Sampling Contacts	Date Shipped		Date Samples Rec'd
(name)	Site Name/Code	Attn	Received By
(phone)			

Sample Numbers	Sample Description Lab, Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

For Lab Use Only

Date of Original Issue: 03/31/91

Title: Sample Custody

FIGURE 10A

SPECIAL ANALYTICAL SERVICE PACKING LIST

U.S. ENVIRONMENTAL PROTECTION AGENCY  
CLP Sample Management Office  
P.O. Box 818 - Alexandria, Virginia 22313  
Phone: 703/557-2490 - FTS/557-2490

SAS Number  
1000 - A

SPECIAL ANALYTICAL SERVICE  
PACKING LIST

Sampling Office <u>Region I</u>	Sampling Date(s) <u>11/2 - 11/4/88</u>	Ship To <u>SAS LAB</u>	For Lab Use Only
Sampling Contact <u>Joe Samper</u> (name)	Date Shipped <u>11/4/88</u>	<u>100 Main Street</u>	Date Samples Rec'd
<u>703/555-1234</u> (phone)	Site Name/Code <u># 01</u>	<u>Anytown, CO 80706</u>	Received By
		Attn <u>Jim Smith</u>	

Sample Numbers	Sample Description Lo., Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1. <u>1000A-01</u>	<u>Low Conc. Water - 2.4-D; 2.4,5-TP</u>	
2. <u>1000A-02</u>	"	
3. <u>1000A-03</u>	"	
4. <u>1000A-04</u>	"	
5. <u>1000A-05</u>	"	
6. <u>1000A-06</u>	"	
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

For Lab Use Only

White - SMO Copy, Yellow - Region Copy, Pink - Lab Copy (for return to SMO), Gold - Lab Copy

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The sampler should complete the list by recording the SAS number, site name, location, sampling date, shipment date, analysis laboratory, sampling office (the organization that did the sampling), sampler names, sampler telephone number, individual SAS sample numbers, and sample description. The description must include the sample matrix, concentration (if applicable), and analyses to be done. After completing the list, the sampler should send the bottom two copies to the laboratory with the sample shipment. Following sample shipment, the sampler should send the top copy to the SMO and should retain the second copy as a file copy.



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**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

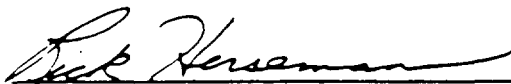
**STANDARD OPERATING PROCEDURE**

**PACKAGING AND SHIPPING SAMPLES**

**SOP NO. 019**

**REVISION NO. 4**

Approved by:



Quality Assurance Officer

7/11/94

Date

Date of Original Issue: 03/31/91

Title: Packaging and Shipping Samples

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## **1.0 BACKGROUND**

In any sampling program, the integrity of a sample must be ensured from its point of collection to its final disposition. Procedures for classifying, handling, and shipping samples are described below. Steps in the procedure should be followed to ensure sample integrity and to protect the welfare of persons involved in shipping and receiving samples. When sent by common carrier, the packaging, labeling, and shipping of hazardous wastes and substances are regulated by the U.S. Department of Transportation [DOT, Code of Federal Regulations, Title 49, (49 CFR)].

### **1.1 PURPOSE**

This standard operating procedure (SOP) establishes the requirements and procedures for packaging and shipping samples. It has been prepared in accordance with the U.S. Environmental Protection Agency (EPA)/National Enforcement Investigation Center (NEIC) "User's Guide to the EPA Contract Laboratory Program." Sample packaging and shipping procedures described in this SOP should be followed for all sample packaging and shipping unless revised by EPA. All revisions will be documented in the field logbook.

### **1.2 SCOPE**

This SOP applies to sample classification, packaging, and shipping.

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### 1.3 DEFINITIONS

**Custody Seal** – A custody seal is a tape-like seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been packed for shipping.

**Environmental Samples** – Environmental samples typically contain low concentrations of contaminants and require only limited precautionary procedures. Only those samples meeting the required specifications of the contract laboratory program (CLP) low-concentration designation should be considered environmental samples. If any doubt exists about the extent of contamination, samples should be treated as hazardous.

**Hazardous Samples** – Hazardous samples should be packaged and labeled according to procedures specified by the federal DOT or the state DOT, whichever is more stringent. Hazardous samples meet the required specifications of the CLP medium- or high-concentration designations. Samples containing an unknown concentration of contaminants must also be considered hazardous. DOT has established a classification and priority system for hazardous material (see Table 1). Specific chemicals can be classified by the tables in 49 CFR 172.101 or 49 CFR 172.102.

### 1.4 REFERENCES

U.S. Environmental Protection Agency, 1988, User's Guide to the Contract Laboratory Program.  
EPA Office of Emergency and Remedial Response, Washington, D.C.

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**TABLE 1**  
**DOT HAZARDOUS MATERIALS CLASSIFICATION**

1. Radioactive Material
2. Poison A
3. Flammable Gas
4. Nonflammable Gas
5. Flammable Liquid
6. Oxidizer
7. Flammable Solid
8. Corrosive Material (liquid)
9. Poison B
10. Corrosive Material (solid)
11. Irritating Materials
12. Combustible Liquid (in containers having a capacity exceeding 110 gallons)
13. Other Regulated Material (ORM)-B
14. ORM-A
15. Combustible Liquid (in containers having a capacity of 110 gallons or less)
16. ORM-E

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Note:

PRC will not ship explosives, so they have been omitted. ORM-C and ORM-D are not relevant for hazardous waste samples.

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## **1.5 REQUIREMENTS AND RESOURCES**

The following equipment is required for proper packaging and shipping of samples:

- All normal sampling equipment (containers, labels, ice, chain-of-custody forms, vermiculite, coolers, and so on) as given in the site-specific sampling plan. Note that only inert noncombustible packing material (not plastic chips) can be used.
- Paint cans to hold sample containers
- Labels for hazardous materials, such as flammable liquid, flammable solid, and so on
- Special airbills for hazardous material shipment

## **2.0 PROCEDURES**

The following procedures apply to handling liquid and solid samples.

### **2.1 PACKAGING ENVIRONMENTAL SAMPLES**

Environmental samples are collected in an appropriate container, sealed, and labeled. The container is then sealed inside a ziplock polyethylene bag. The sealed package is then placed in an iced cooler, and packed to prevent breakage (for example, sample containers are surrounded with vermiculite or other inert packaging material). After chain-of-custody forms are completed, they are sealed in plastic bags and taped inside the lid of the cooler.

Custody seals will be signed and attached to the cooler so that any tampering will be detected.

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## 2.2 CLASSIFYING HAZARDOUS SAMPLES

First, classify the hazardous samples following the priorities given in Table 1. Initially, all samples should be surveyed for radiation. If radiation levels are below 0.5 millirems per hour (mR/h) at the surface of the package material, the sample should not be shipped as radioactive. If the radiation level exceeds 0.5 mR/h, the sample should be shipped as radioactive. Consult 49 CFR 173, Subpart I, for proper definition and shipping of a radioactive sample.

Poison A is the next category on the DOT list (see Table 2). According to DOT, Poison A substances are gases or liquids that are life threatening in very small amounts (49 CFR 173.326). Many of the Poison A materials are gases or compressed gases that would not be found in drum-type containers. Liquid Poison A substances would probably be found in closed containers, a situation that presents a "worst case" scenario. Not all samples found in drums should be labeled "Poison A." Based on the information available, a judgment must be made as to the hazard class of the sample. If the sample is suspected or determined to fall within the "Poison A" classification, packaging procedures specified by DOT should be followed as specified in 49 CFR 173.326-328.

The next two classifications in the DOT series are "flammable gas" and "nonflammable gas" (49 CFR 173.300). Few, if any, gas samples are expected to be collected at uncontrolled hazardous waste sites. Use this category only when shipping containerized gases or gas samples.

The next category is "flammable liquids" (49 CFR 173.115). Hazardous samples in liquid form, unless known to fall into a lower category, should be handled, packaged, and shipped at this level of concern. Lesser categories will generally not be considered because flashpoint testing required to drop to a lower level is difficult and possibly dangerous in the field. Samples should be handled at the "flammable" level, rather than undertake a field determination of flash point.

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TABLE 2

THE PHYSICAL STATE OF CLASS A POISONS AT ROOM TEMPERATURE

<u>COMPOUND</u>	<u>PHYSICAL STATE</u>
Arsine	gas
Bromoacetone	liquid
Chloropicrin and methyl chloride mixture	gas
Chloropicrin and nonflammable, nonliquified compressed gas mixture	gas
Cyanogen	gas
Cyanogen chloride	gas (above 13° C)
Gas identification set	gas
Germane	gas
Hexaethyl tetraphosphate and compressed gas mixture	gas
Hydrocyanic acid (prussic solution)	liquid
Hydrocyanic acid, liquified	gas
Insecticide liquified gas (containing Poison A or Poison B material)	gas
Methyldichloroarsine	liquid
Nitric oxide	gas
Nitrogen dioxide, liquid	gas
Nitrogen peroxide	gas
Nitrogen tetroxide	gas
Parathion and compressed gas mixture	gas
Phosgene (diphosgene)	gas (liquid)
Phosphine	gas
Tetraethyl dithiopyrophosphate and compressed gas mixture	gas
Tetraethyl pyrophosphate and compressed gas mixture	gas

Note:

Phosgene and diphosgene are two chemicals covered by one name in DOT regulations.

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Solids samples known or suspected to be flammable should be shipped as "flammable solids" (49 CFR 173.150). Based on characteristics of the sample and DOT regulations, nonflammable solids may be shipped as "Poison B" (49 CFR 173.343), "corrosive" (49 CFR 173.240), or "irritant materials" (49 CFR 173.381).

A single package containing less than 5 pounds of solid or less than 1 pint of liquid hazardous waste may be shipped as Other Regulated Material (ORM). If the material is known, the ORM-A or ORM-B classification may be used. ORM-A and ORM-B materials are listed in 49 CFR 173, parts K and L. If the material is unknown or not listed under parts K and L, the ORM-E category may be used. The ORM-E category is used for hazardous waste liquids and solids not otherwise specified.

Because of the low levels of contamination expected at most hazardous waste sites, most samples will be treated as environmental samples.

### **2.3 SAMPLE PACKAGING**

An overview of the procedures to follow for packaging samples is presented below. These procedures include the following:

- Collect samples in appropriate sample containers (see SOP No. 017, Sample Collection Container Requirements, or the site-specific sampling plan). When collecting a solid material, the container and its contents shall not exceed 1 pound net weight. Large quantities of solid material (up to 1 gallon) may be collected if the flash point of the sample can be determined to be 73 degrees Fahrenheit (° F) or higher. In these cases, this information should be marked on the outside of the shipping container, but only a single (1 gallon or less) bottle may be packed in each shipping container. Shipping papers must state that the flash point is 73° F or higher.
- Seal the sample container.



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- Attach a completed sample identification tag (see SOP No. 018, Sample Custody, or the site-specific sampling plan).
- Place each container in a separate 2-millimeter thick (or thicker) recloseable, polyethylene bag. Position the sample identification tag so it can be read through the bag.
- Place each sealed bag inside a metal can or other DOT-approved container. Use only one bag per container. Pack metal can with enough noncombustible, absorbent, cushioning material (such as bentonite, vermiculite, or diatomaceous earth) to prevent breakage and provide for absorption of liquid. Close the metal can and secure the lid with clips, tape, or other positive means.
- Use labels supplied by the Regional Equipment Manager for each DOT-approved container. Label each container with the appropriate DOT hazardous labels. [For example, "Cargo Aircraft Only (Danger - Peligro)" and one of the following: "Flammable Liquid," "Flammable Solid," "Dangerous When Wet," or "Corrosive"]. Label conservatively and use "Flammable Liquid N.O.S. UN1922" for most liquids and "Flammable Solid N.O.S. UN1325" for most solids. If the sample is definitely not a flammable liquid or solid, use another category in the DOT hierarchy. Use "Not Otherwise Specified" (N.O.S.) when the sample is definitely not identified. Identify the sample by name and UN identifier when known.
- Place metal cans, other DOT-approved containers, or a single 1-gallon bottle into a strong outside shipping container, such as a metal picnic cooler or an approved fiberboard box. Surround with noncombustible, absorbent packing material for stability during transport. See Figure 1 for a summary of CLP hazardous sample packaging.
- Attach the same DOT labels as above; a limited quantity label; and a laboratory name and address label to the top and front of the cooler. Place "This End Up" labels on adjacent sides of the cooler. Do not allow labels to overlap or be covered by strapping tape.
- Attach custody seals, and secure the shipping container with strapping tape.

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## 2.4 SHIPPING PAPERS

Use abbreviations only as specified below. Complete the bill of lading supplied by the carrier. Sign the certification statement. If no certification statement is provided by the carrier, use the standard industry form. Include the following information in the order listed: "Flammable Liquid, N.O.S. UN1933," "Flammable Solid, N.O.S. UN1325," "Cargo Aircraft Only," "Limited Quantity" (or "Ltd. Qty."), "Laboratory Samples," "Net Weight \_\_\_" or "Net Volume \_\_\_" of hazardous contents, by item, if more than one metal can is inside of the exterior container. Place the net weight or net volume just before or just after the "Flammable Liquid, N.O.S." or "Flammable Solid, N.O.S." description.

Include a complete chain-of-custody record in a recloseable, polyethylene bag in the sample container. Containers must be locked or otherwise sealed. Immediately upon shipment of samples, call the sample management office (SMO) with the site-specific information (if using the CLP RAS). If samples are shipped to a SAS or non-CLP laboratory, the laboratory should be called directly with the site-specific information. Record the communication in the field logbook. A checklist for coordinating the tasks involved in sample shipment is provided on Figure 1.

## 2.5 TRANSPORTATION

Hazardous or environmental samples may be transported by PRC personnel in private vehicles. Samples will be shipped by Federal Express or another common carrier; however, hazardous samples cannot be transported by any carrier that also carries passengers.

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## 2.6 POTENTIAL PROBLEMS

The following potential problems may occur during sample shipment:

- Incorrect or incomplete paperwork
- Laboratory receipt of incorrect samples
- Insufficient volume for analysis requested
- Broken or leaking samples

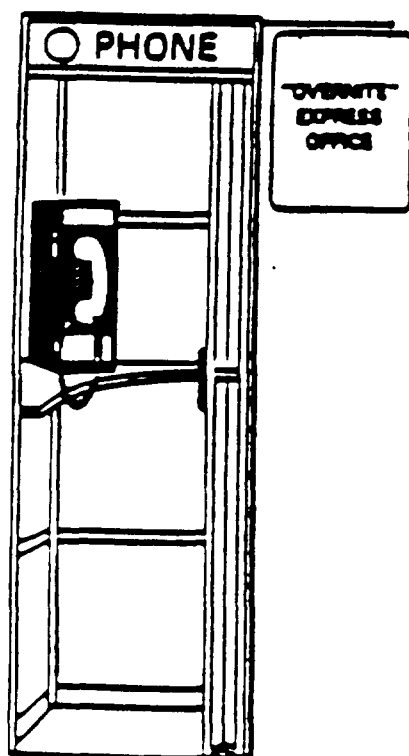
If any of these problems are encountered, immediately contact SMO (if using the CLP RAS) and the PRC Project Manager. If using a SAS or non-CLP laboratory, the laboratory and PRC Project Manager should be called immediately with any problems encountered.

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**FIGURE 1**  
**SAMPLE SHIPMENT COORDINATION CHECKLIST**

**IMMEDIATELY UPON SHIPMENT OF SAMPLES, SAMPLERS CALL  
SMO OR RSCC (AS APPROPRIATE)**



- **CASE AND/OR SAS NUMBER**
- **NAME OF LABORATORY**
- **DATE OF SHIPMENT**
- **CARRIER, AIRBILL  
(SHIPMENT) NUMBERS AND  
TYPE OF SERVICE**
- **NUMBER AND MATRICES  
(WATERS, SOILS, ETC.) OF  
SAMPLES SHIPPED**
- **INFORMATION ON  
COMPLETIONS, CHANGES,  
DELAYS, CONTINUATIONS,  
ETC, PERTINENT TO THE  
CASE**
- **SAMPLER'S NAME, REGION,  
AND PHONE NUMBER**
- **SMO MUST BE NOTIFIED BY  
3:00 PM ON FRIDAY FOR  
SAMPLES INTENDED FOR  
SATURDAY  
DELIVERY/PICKUP**

**SOP APPROVAL FORM**

**PRC ENVIRONMENTAL MANAGEMENT, INC.**

**STANDARD OPERATING PROCEDURE**

**RECORDING NOTES IN THE FIELD LOGBOOK**

**SOP NO. 024**

**REVISION NO. 1**

Approved by:

*William H. Hester*  
Quality Assurance Officer

5/15/93  
Date

## **1.0 BACKGROUND**

The field logbook should contain detailed records of all the field activities, interviews of people, and observations of conditions at a site. Entries should be described in as much detail as possible, so that personnel can accurately reconstruct the activities and events which have taken place during field assignments. Field logbooks are considered accountable documents in enforcement proceedings and may be open to review. Therefore, the entries in the logbook must be accurate, detailed, and reflect the importance of the field events.

### **1.1 PURPOSE**

The purpose of this standard operating procedure (SOP) is to provide guidance to ensure that logbook documentation for any field activity is correct, complete, and adequate. Logbooks are used for identifying, locating, labelling, and tracking samples. A logbook should document any deviations from the project approach, work plans, quality assurance plans, safety plans, sampling plans, and any changes in project personnel. They also serve as documentation of any photographs taken during the course of the project. In addition, the data recorded in the logbook may assist in the interpretation of the analytical results. A complete and accurate logbook also aids in maintaining good quality control. Quality control is enhanced by the proper documentation of all observations, activities, and decisions.

### **1.2 SCOPE**

This SOP establishes the general requirements and procedures for recording notes in the field logbook.

### **1.3 DEFINITIONS**

None.

## 1.4 REFERENCES

Compton, R.R. 1985. *Geology in the Field*. John Wiley and Sons. New York, N.Y.

## 1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Field logbooks
- Ballpoint pens with permanent ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water resistant and acid-proof covers; they should have preprinted lines and wide columns. They should be approximately 7 1/2 by 4 1/2 inches or 8 1/2 by 11 inches in size. Loose-leaf sheets are not acceptable for field notes. If notes are taken on loose paper, they must be transcribed as soon as possible into a regular field logbook by the same person who took the notes.

Logbooks can be obtained through the Document Control Administrator (DCA) for each office. The DCA will have assigned each logbook an identification number. The DCA will make sure the pages in the logbooks are preprinted with consecutive numbers or are consecutively numbered by hand. If the numbers are written by hand, then numbers should be circled so that they are not confused with data.

## 2.0 PROCEDURES

The following subsections provide the general layout of a field logbook and detailed procedures for completing a field logbook.

## 2.1 GENERAL GUIDELINES

- A separate field activity logbook must be maintained for each project. If a site consists of multiple subsites, designate a separate logbook for each subsite. For special tasks, such as periodic well water-level measurements, data from multiple subsites may be entered into one logbook which contains only one type of information.
- All logbooks must be bound and contain consecutively numbered pages.
- No pages can be removed from the logbook for any purpose.
- All field activities, meetings, photographs, and names of personnel must be recorded in the site logbook.
- All logbooks pertaining to a site or subsite should be assigned a serial number based on the date the logbook is issued to the project manager. The first logbook should be assigned number 1, the next logbook issued assigned number 2, and so on. The project manager is to maintain a record of all logbooks issued under the project.
- All information must be entered with a ballpoint pen with waterproof ink. Do not use pens with "wet ink," because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective.
- Begin a new page for each day's notes.
- Write notes on every line of the logbook. If a subject changes and an additional blank space is necessary to make the new subject title stand out, skip one line before beginning the new subject. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page.
- Draw a diagonal line on any blank spaces of four lines or more to prevent unauthorized entries.



## 2.2 LOGBOOK FORMAT

The layout and organization of each field logbook should be consistent with other field logbooks. Guidelines for the cover, spine, and internal pagination are discussed below.

### 2.2.1 FORMAT OF THE COVER AND SPINE OF FIELD LOGBOOKS

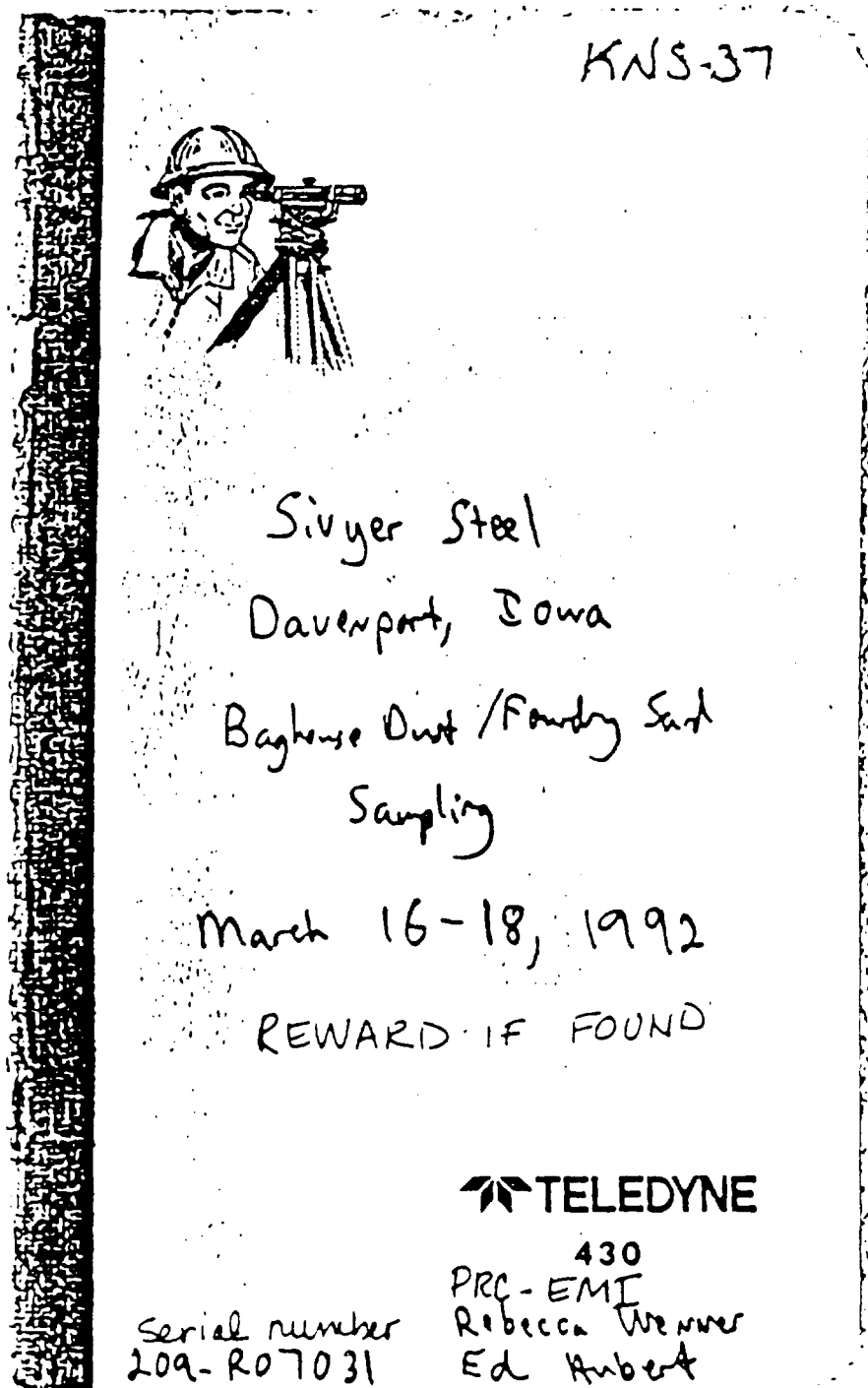
Write the following information in clear capital letters on the front cover of each logbook. An example of the cover of a logbook is included as Figure 1.

- Logbook identification number (assigned by the DCA)
- The serial number of the logbook (assigned by the project manager)
- Name of the site, city, and state
- Name of subsite if applicable
- Type of activity
- Beginning and ending dates of activities entered into the logbook
- "PRC EMI," City and State
- "REWARD IF FOUND"

Some of the information listed above, such as the list of activities and ending dates, should be entered after the entire logbook has been filled or after it has been decided that the remaining blank pages in the logbook will not be filled.

The spine of the logbook should contain an abbreviated version of the information on the cover. For example: "1, Col. Ave., Hastings, 5/88 - 8/88."

FIGURE 1  
COVER OF THE FIELD LOGBOOK



## **2.2.2 First Page of the Field Logbook**

Spaces are usually provided on the inside front cover (or the opening page in some logbooks), for the company name ("PRC EMI"), address, and telephone number. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page.

## **2.3 ENTERING INFORMATION IN THE LOGBOOK**

Enter the following information at the beginning of each day or whenever warranted during the course of a day:

- Date
- Starting time
- Specific location
- General weather conditions and approximate temperature
- Names of personnel present at the site. Note the affiliation(s) and designation(s) of all personnel.
- Equipment calibration and equipment models used.
- Changes in instructions or activities at the site.
- Levels of personal protective clothing and equipment.
- A general title of the first task undertaken (for example, well installation at MW-11, decon at borehole BH-11, groundwater sampling at MW-11).
- Provide an approximate scale for all diagrams. If this can't be done, write "not to scale" on the diagram. Indicate the north direction on all maps and cross-sections. Label features on each diagram.
- Corrections should be made by drawing a single line through the entry being corrected. Initial and date any corrections made in the logbook.
- The person recording notes is to initial each page after the last entry. No information will be entered in the area following these initials.

- At the end of the day, the person recording notes is to sign and date the bottom of the last page. Indicate the end of the work day by writing "Left site at (time)." A diagonal line will be drawn across any blank space to the bottom of the page.

The following information should be recorded in the logbook after taking a photograph:

- Time, date, location, direction, and if appropriate, weather conditions
- Description of the subject photographed and the reason for taking the picture
- Sequential number of the photograph and the film roll number
- Name of the photographer

The following information should be entered into the logbook when taking samples:

- Location description
- Sampler's name
- Collection time
- Designation of samples as a grab or composite sample
- Type of sample (water, sediment, soil gas, etc.)
- On-site measurement data (pH, temperature, specific conductivity)
- Field observations (odors, colors, weather, etc.)
- Preliminary sample description
- Type of preservative used
- Instrument readings

## **2.4 PRECAUTIONS**

Custody of field logbooks must be maintained at all times. Field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession.

Logbooks are official project documents and must be treated as such.

**ATTACHMENT B**

**MANUFACTURER'S INSTRUCTIONS  
FOR  
PERSTORP WATER ANALYZER,  
GEO GROUP INFRA-RED GA-90 ANALYZER,  
AND HACH DR/820 COLORIMETER**

(87 Sheets)

## **PERSTORP WATER ANALYZER**

PERSTORP ANALYTICAL ENVIRONMENTAL  
Water Analyzer Models 51500/51501/51600/51601  
(P/N: 51601)  
Technical Manual



1-800-332-0435



Perstorp Analytical

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Environmental

TECHNICAL MANUAL  
WATER ANALYZER  
MODELS  
51500/51501/51600/51601

AT PERSTORP ANALYTICAL ENVIRONMENTAL, COMMITMENT IS THE  
PRIMARY INGREDIENT, SATISFIED CUSTOMERS IS THE OUTCOME.



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## 1.0 INTRODUCTION

The WATER ANALYZER is a compact, rechargeable, battery-operated, field instrument which simultaneously measures the dissolved oxygen level, pH, conductivity, and temperature of water and aqueous solutions.

The user can elect to display either uncompensated values or values which have been compensated for external effects. In the compensated mode, the conductivity and pH values will be compensated for temperature and the dissolved oxygen reading for temperature, salinity, and atmospheric pressure.

All of these parameters, except atmospheric pressure, are measured with a single compact probe which is equipped with a specific cable length (10', 25', 50', 100', 150', and 200' are the standard lengths). This allows remote measurements to be taken, without the need to draw a sample.

The WATER ANALYZER also contains a built-in measurement log to manually store readings. This allows up to 199 sets of measurements to be saved in the field for later review. (See Section 9.0 for a description of Auto Data Logging and RS-232 operations.)

### 1.1 POWER

The battery in the WATER ANALYZER will provide about 8 hours of continuous operation. A low-battery signal will appear when approximately 1 hour of use is left. (The meter has an Auto-shut Off Safety feature which disconnects the power before the battery voltage drops below a level dangerous to the memory.) Recharge time for the battery is 15 hours. The WATER ANALYZER contains a back-up battery and will retain the stored calibration information and the measurement log for at least 30 days without external power.

An A/C adaptor-charger is provided for charging the WATER ANALYZER. An optional 12V automobile cigarette lighter adapter is available. Extreme temperature during recharging is not recommended. It is also recommended that the vehicle not be started while the WATER ANALYZER is plugged in.

The WATER ANALYZER uses a sealed lead-acid gelled electrolyte battery. Unlike a NiCad battery, these batteries can be recharged before they have been fully discharged. Incomplete charge and discharge cycles will have little effect on battery life or capacity. The battery is also protected from overcharge by an internal battery maintenance circuit which allows the unit to be left connected to the AC adapter/charger whether the meter is in use or not. The battery requires recharging at least once every 3-4 months during extended periods of non-use.

## 1.2 OPTIONS

A kit of calibration standards is available. This kit contains quantities of pH 4, pH 7, and pH 10 buffers; pH boot solution; a set of conductivity standards (73.9 uS/cm, 718 uS/cm, 6.67 mS/cm, and 58.6 mS/cm); a container of deionized water; a package of oxygen sensor membranes; and oxygen filling solution.

Several factory installed hardware options are available: longer cable lengths, automatic barometric pressure compensation, and RS-232 computer interface with auto data logging capabilities.

Additional probes, of any cable length, may be ordered for a previous purchased meter. Additional cable lengths cannot be retro-fitted to existing probes.

The automatic barometric pressure compensation option may be added to a previously purchased unit, by the factory.

The RS-232 computer interface option allows parameter values, which have been stored, to be down-loaded via an RS-232 link to a computer. This enables the user to incorporate data values directly into analysis programs. Down-load software is provided for MS-DOS computers or use your favorite communications software. The RS-232 option can be added by the factory at anytime.

## 2.0 METER FAMILIARITY

The WATER ANALYZER meter has been designed to be fairly rugged and weather resistant. It is not, however, waterproof. Do not drop the WATER ANALYZER meter into a lake, pond or other body of water or allow it to become overly wet in the rain.

- 2.1 Used to turn the WATER ANALYZER on and off.
- 2.2 Used to select the operating mode.
- 2.3 LCD display. Used to display user prompts and measured values.
- 2.4 The UP and DOWN arrow keys scroll through menus and set values.
- 2.5 Used to select menu items and skip calibration steps.
- 2.6 Used to store displayed values in the measurement log and calibration information.

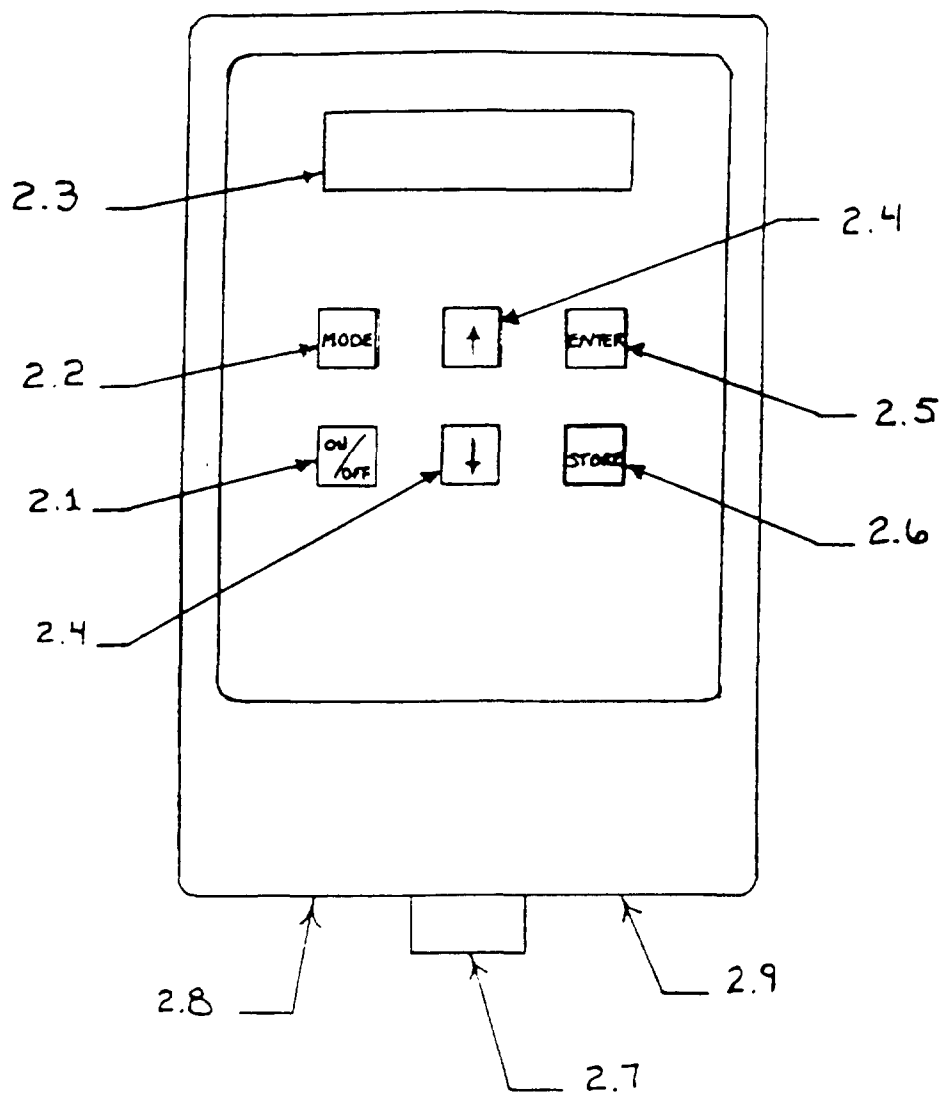


Figure 1

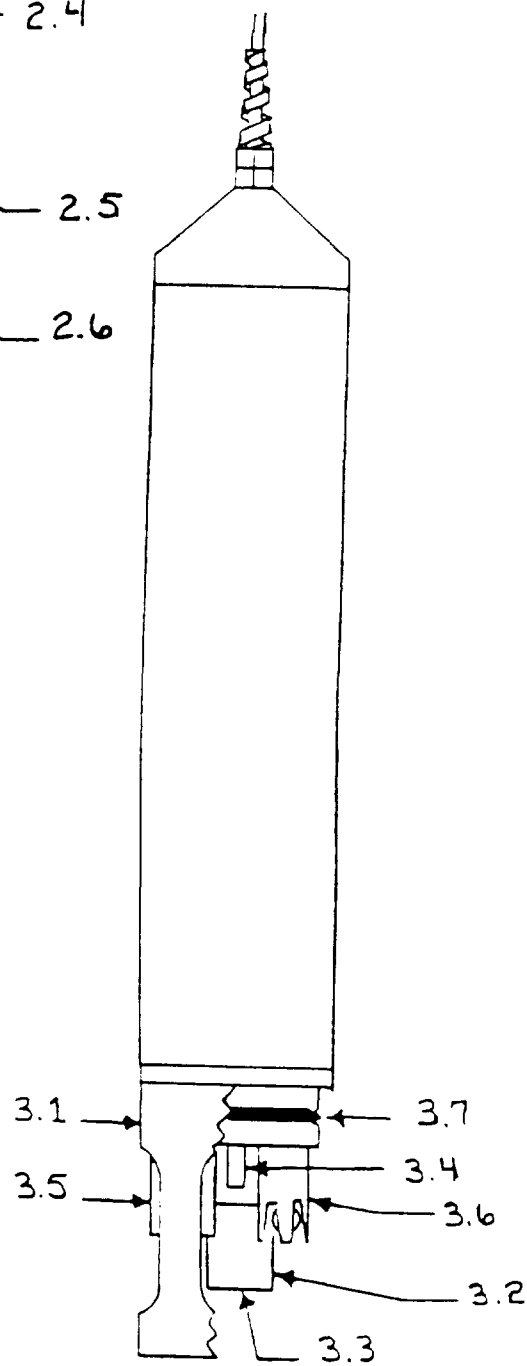


Figure 2

2.7 Probe connection. If it should be necessary to disconnect the probe from the meter, this may be done as follows;

- 2.7.1 Locate the connector which attaches the probe cable to the meter.
- 2.7.2 Rotate the fluted locking ring on the probe cable connector about 1/3 turn.
- 2.7.3 Gripping the cable connector body, gently pull the connector away from the meter. Do not twist the cable or put any unnecessary strain on the cable.

To reconnect;

- 2.7.4 Line up the cable plug's semi-cylindrical index with the corresponding notch in the jack of the meter connector.
- 2.7.5 Gently push the plug into the jack, do not force.
- 2.7.6 Rotate the fluted locking ring of the probe cable plug about 1/3 turn to lock the plug and jack connectors together.

2.8 Battery charger input.

2.9 RS-232 input/output.

### 3.0 PROBE FAMILIARITY

- 3.1 Probe guard. The probe guard is designed to protect the sensors while allowing the test solution to flow past the sensors. The probe guard is a 1 $\frac{1}{2}$ " x 2 $\frac{5}{8}$ " (O.D.xL) Delrin piece, held in place by the guard retaining spring which is compressed as the guard slides into place. Remove the probe guard prior to removing any sensor. Make sure the guard is in place prior to using the probe.
- 3.2 Oxygen sensor. The oxygen sensor is a black Delrin,  $\frac{7}{16}$ " x 4" (DxL) polarographic type sensor, with a two sectioned cavity filled with oxygen electrode filling solution.
- 3.3 Oxygen membrane. The oxygen membrane is made of a special material through which gases but not liquids may pass. It should be stretched tightly over the tip of the oxygen sensor without wrinkles or tears.
- 3.4 Temperature sensor is in stainless steel housing. This sensor is not field replaceable
- 3.5 Conductivity electrode. This sensor consists of graphite embedded in an epoxy/delrin casing. It requires very little maintenance. If it fails, it can be replaced by the factory.

- 3.6 pH sensor. The pH sensor is an amber, epoxy,  $\frac{7}{16}$ " x  $2\frac{3}{4}$ " (DxL) electrode. The sensor should be kept wet at all times. A boot is provided for this purpose. The recommended solution for storage is 10% KCl in pH 4 buffer. If the pH sensor should fail, it may be replaced while in the field.
- 3.7 Guard retaining spring.

#### 4.0 OPERATION

This section describes the basics of taking a measurement with the WATER ANALYZER. Sections 5 and 6 describe the details of setting the instrument configuration and calibrating the meter.

##### 4.1 REMOVING pH BOOT

Before a measurement can be made, the boot must be removed from the pH sensor. The boot is a small polyethylene capsule which covers the pH sensor. (See 3.6 for the location of the pH sensor.)

Remove the boot by gently sliding it off of the pH sensor body. Hold the pH sensor body so that it is not pulled out of the probe as the boot is removed. The boot is shipped from the factory filled with a boot solution of 10% KCl in a pH 4 buffer.

When storing the probe after taking a measurement, be sure to replace the boot. It should be filled with the boot solution. If none is available, the pH 4 buffer may be used.

As with any pH sensor, the solution in which the sensor's pH electrode has been stored, will affect its calibration. If a solution other than 10% KCl in pH 4 buffer is used as a storage solution, it will become necessary to soak the electrode in the boot solution for at least 1 day prior to calibrating. This will insure maximum stability and accuracy.

**DO NOT STORE THE pH ELECTRODE IN DISTILLED WATER.**

**DO NOT STORE THE pH ELECTRODE DRY.**

## 4.2 OXYGEN SENSOR PREPARATION

Pull the sensor out from the probe body (see Section 11.0) and disconnect the sensor from the probe.

Unscrew the two cavities from the sensor and from each other. Using tweezers, carefully center a new membrane (Figures 3 & 4) over the end of the larger section. Twist the smaller section back on, tightly. The membrane should be stretched tightly across the opening. A package containing membranes was included with your meter.

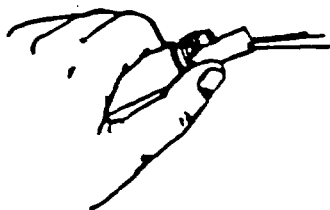


Figure 3



Figure 4

Fill the cavity section with oxygen filling solution and insert the electrode section and tighten. Reconnect the sensor to the probe and slide back into place.

The oxygen sensor will need to standardize for approximately 20 minutes prior to use. To standardize the sensor, place the probe in distilled water or in a plastic bag with a wet sponge or cloth. The bag should be secured so that a saturated air environment develops.

## 4.3 TURNING ON THE WATER ANALYZER

To turn the WATER ANALYZER on, press the ON/OFF key (item 2.1). The meter should beep and display the message "WATER ANALYZER Version 7.0.3" for about 3 seconds. After this time it will begin to display the current sensor readings. Units with factory installed barometers will alternate between displaying the current temperature and the current atmospheric pressure. (See Section 5.8 if you do not want the pressure reading displayed.)

To change the units in which the information is displayed, the "Setup Instrument" mode (See Section 5.0) must be used. This mode is also used to select which external effects the meter will automatically compensate for.

#### 4.4 STORE READINGS (LOG MEASUREMENTS)

Pressing the STORE key, while the WATER ANALYZER is displaying readings, will result in the data being stored in the measurement log. The numbered location assigned to the logged reading will appear on the display, near the temperature readout, for about 3 seconds. (Location numbers 1 - 99 are as is. Location numbers 100 - 109 will be labeled A0 - A9, 110 - 119 will be labeled B0 - B9, and so on.)

Stored readings will remain stored even when the WATER ANALYZER is turned off. Data does not need to be reviewed or down-loaded in the field.

#### 5.0 SETUP INSTRUMENT

The Setup Instrument mode allows the selection of units for the pH, temperature, pressure, conductivity, and oxygen readings. It also allows selection of the extrinsic effects which the meter will automatic compensation for.

To select the Setup Instrument mode, press the MODE key to reach the Mode menu. Then press the UP or DOWN arrow key until you reach the "Setup Instrument" prompt. Pressing the ENTER key will then activate the Setup Instrument mode.

##### 5.1 UNITS FOR TEMPERATURE DISPLAY

The first prompt in the Setup Instrument mode, "Temp. units:" is used to select either Fahrenheit or Celsius degrees for the temperature display. Press either the UP or DOWN arrow keys to toggle between °F and °C.

Press either the ENTER or the STORE keys when the desired choice is displayed. This will save your selection and advance to the pH prompt.

##### 5.2 UNITS FOR pH DISPLAY

The second prompt in the Setup Instrument mode, "pH in:" is used to select either pH or mV for the pH display. Press either the UP or DOWN arrow key to toggle between pH and mV.

Press either the ENTER or the STORE keys when the desired choice is displayed. This will save your selection and allow advancement to the oxygen setup mode.



### 5.3 UNITS FOR OXYGEN DISPLAY

The third prompt in the Setup Instrument mode, "Oxygen in:" is used to select either ppm or percent of saturation for the oxygen concentration display. Press either the UP or DOWN arrow key to toggle between ppm and % (for percent of saturation).

Press either the ENTER or the STORE keys when the desired choice is displayed. This will save your selection and advance to the Oxygen Compensation mode

### 5.4 OXYGEN COMPENSATION

The fourth prompt in the Setup Instrument mode, "Comp.Oxygen:" allows you to control whether or not the oxygen readings will be corrected for salinity.

The polarographic sensor used by the WATER ANALYZER measures the chemical activity of the oxygen in the water rather than its physical concentration. In dilute solutions, the activity and concentration are indistinguishable from each other so no problems arise. As the solution becomes increasingly concentrated, with either oxygen or other matter such as salts, the activity will increase above the physical concentration. This is commonly referred to as salting out. At very high concentrations, an error of 10% or so in the oxygen reading may be observed. Since the WATER ANALYZER measures the salt concentration as well as the oxygen activity, it can correct for the salt concentration to provide an actual physical oxygen concentration.

To enable the automatic correction of the oxygen reading, for the salinity, press the UP or DOWN arrow key to display the answer Yes, then press STORE. To disable this feature press the UP or DOWN arrow key to display the answer No, then STORE. When measuring relatively clean fresh water, this correction will not affect the reading.

After you have saved your selection, the display will advance to the next item, which allows you to select either a manually entered oxygen calibration value or an automatically generated value.

### 5.5 OXYGEN CALIBRATION VALUE

The fifth prompt, in the Setup Instrument mode, either "Automatic Ox Cal." or "Manual Ox Cal.", allows you to select whether the oxygen calibration is to be done with a manually entered value or with an automatically determined one. The

UP and DOWN arrow keys may be used to toggle between these two choices.

If you have selected Manual Ox Cal., during oxygen sensor calibration, you will be asked to specify the oxygen concentration in the water in which the calibration is being performed. This is useful when strict correlation between the values from the WATER ANALYZER and an older, less sophisticated, oxygen meter is required.

If you have selected Automatic Ox Cal., you will be asked to specify the atmospheric pressure when calibrating the oxygen sensor. The WATER ANALYZER will calculate the appropriate value for the oxygen concentration based upon the water's temperature and the specified pressure. Once the desired selection is displayed, press either the ENTER or the STORE key to record your choice and advance to the conductance prompts.

## 5.6 UNITS FOR CONDUCTANCE DISPLAY

The sixth prompt in the Setup Instrument mode is "Conductance:". This is used to select the units to be used for displaying the conductance. The conductance may be displayed in Siemens per cm (S), mhos per cm (symbol for mho), or TDS (TDS, as sodium chloride).

Due to the range of conductivity encountered, the values displayed will be in uS/cm (uS), mS/cm (mS), micromhos/cm, or millimhos/cm, or, for TDS readings, in ppm (parts-per-million) or ppt (parts-per-thousand).

Pressing the UP or DOWN arrow key will cycle you through the list of choices.

When the desired conductivity units are displayed, press either the STORE or the ENTER key to save your selection. If you selected TDS, you will be returned to the Mode menu. If you selected Siemens or mhos for the conductivity units, the ENTER or STORE keys will advance you to the next prompt used to select the conductivity compensation values.

## 5.7 CONDUCTIVITY COMPENSATION

The seventh prompt of the Setup Instrument mode is "Comp. Cond:". This prompt, which only appears if you are displaying the conductivity in Siemens or mhos, is used to select the desired temperature and pressure compensation values for the conductivity readings.

The conductivity readings may be left uncompensated. In this case the WATER ANALYZER will read the actual conductivity of the solution. Be careful when calibrating the WATER ANALYZER, when the "Comp. Cond:" is On since a conductivity standard has its specified conductivity at only one temperature.

Alternatively, the conductivity readings may be corrected for temperature. You can select either 20°C or 25°C as the target temperature. When one of these is selected, the displayed conductivity readings will be the conductivity the measured solution would have at the target temperature, if all of the conductivity is due to the dissolved KCl. In reality, all of the conductivity will not be due to dissolved KCl, so some slight systematic error will be present. This error is usually small enough to neglect.

When the desired compensation has been entered, press either the ENTER or STORE key to save your selection. This will advance you to the next selection.

## 5.8 PRESSURE COMPENSATION

The eighth and final prompt of the Setup Instrument mode is "Pressure in:". It allows you to set the pressure used to compensate for the partial pressure of oxygen in the atmosphere.

Water Analyzers with barometers (factory installed) will first display "Disp. Press". Responding with a YES will inform the meter that the current pressure reading is to be displayed alternating with the temperature readings. A NO response will result in the meter not displaying the current pressure reading.

The pressure will be displayed in "in." (inches of mercury) or torr (mm of Hg). Press the UP or DOWN arrow to select the desired units and press STORE or the ENTER key to save your selection. The meter will then return to the display of current readings.

## 6.0 CALIBRATION

Even though the WATER ANALYZER is calibrated before it leaves the factory, we recommend calibrating it again prior to use. In addition, periodic recalibration is recommended to ensure the accuracy of the displayed readings.

The condition of the pH sensor will be dependent primarily upon its storage conditions. Storing it in the recommended boot solution of 10% KCl in pH 4 buffer will reduce the frequency with which of calibration.

The dissolved oxygen sensor also requires periodic calibration. Organic matter can foul the membrane pores, reducing the sensor's effectiveness. Since the sensor's response is dependent upon the mass transport characteristics of the membrane, as well as the condition of the surface of the electrode, it needs to be recalibrated whenever the membrane is replaced or conditions warrant recalibration.

The conductivity sensor has less stringent calibration requirements than the pH and dissolved oxygen sensors. Frequently, the factory calibration will suffice for the life of the sensor, this is especially true if you are working with only slightly conductive (less than 5 mS/cm) solutions.

Unless very accurate temperature measurement are to be made, the temperature sensor should never need recalibration. The WATER ANALYZER will meet its temperature specification without any user calibration.

Should the temperature sensor need to be recalibrated, it should be done prior to any other calibration procedures. The same holds true for units with installed barometers. Once the temperature has been calibrated, the pressure should be calibrated, if required, prior to calibrating the pH, oxygen or conductivity.

Each of the four sensors in the probe (oxygen, pH, conductivity, and temperature) are calibrated separately. When calibrating, wait until the ADC (Analog Digital Conversion) readout remains relatively constant, for at least 4 cycles, then press STORE.

## 6.1 TEMPERATURE SENSOR CALIBRATION

The simplest sensor to calibrate is the temperature sensor. This is also the most stable sensor, so it is unlikely that calibration will ever be required.

To calibrate the temperature sensor, turn the WATER ANALYZER on and allow the displayed readings stabilize. Press the MODE key to reach the Mode menu and press either the UP or DOWN arrow key until the "Calibrate Temp" prompt is displayed. Press the ENTER key to select the Calibrate Temp mode.

The top line of the display will indicate the temperature set point. Press the UP or DOWN arrow key to change the displayed

value to the actual temperature of the solution into which the sensor is immersed. (The solution temperature should be checked with a NIST traceable thermometer.)

The bottom line will show the "ADC" value. A stable readout (the ADC value remains relatively constant for 4 counts) is important not the actual value. When the readout is stable, press the STORE key to calibrate the temperature sensor and store the calibration information. If you decide not to alter the previously stored calibration information, press the ENTER key to skip this step.

After either the STORE or the ENTER key have been pressed, the WATER ANALYZER will resume displaying the measured values for temperature, pH, conductivity, and oxygen.

We do not recommend calibrating the temperature sensor in air. The evaporation of any water from the temperature sensor could keep its temperature significantly lower than the surrounding air.

## 6.2 OXYGEN SENSOR CALIBRATION

The oxygen sensor used in the WATER ANALYZER requires frequent recalibration for maximum accuracy.

The details of the calibration procedure depend upon whether Automatic or Manual Oxygen calibration was chosen in the Setup Instrument mode.

To perform an oxygen calibration, turn on the WATER ANALYZER and press the MODE key to reach the Mode menu. Press either the UP or DOWN arrow key until the "Calibrate Oxygen" prompt is displayed. Press the ENTER key to select the Calibrate Oxygen mode.

When Automatic Oxygen Calibration (in units without internal barometers) has been selected, the top line will display a prompt for the atmospheric pressure. This, along with the temperature, is used to determine the solubility of oxygen in water. The UP and DOWN arrow keys should be used to adjust the displayed value to the test site atmospheric pressure.

The barometric pressure, as reported by radio and television stations is not the correct atmospheric pressure to use. For standardization, the values reported are corrected to sea level. To convert from the reported value to the actual atmospheric pressure your altitude above sea level must be known. Your local airport should be able to provide this information.

Once your altitude is known, the following table may be used to convert from barometric to atmospheric pressure:

Altitude	Correction Factor
-500 m	1.061
sea level	1.000
500 m	0.942
1000 m	0.887
1500 m	0.835
2000 m	0.785

Multiply the Correction Factor corresponding to your altitude by the standardized barometer reading to get the actual atmospheric pressure. Contact your dealer or the factory, if additional correction factors are needed.

Once the correct pressure has been entered, press either the ENTER or STORE key to save the value and move to the Air Sat Ox Cal step. Wrap the probe in a wet cloth or place in a plastic bag with a few drops of water and tie shut. Do not touch the oxygen membrane. The object of this operation is to have the oxygen and temperature sensors in a 100% humidity environment.

When **Manually** calibrating the oxygen sensor, the top line of the display indicates the oxygen concentration of the standard solution to be used. The UP and DOWN arrow keys may be used to adjust the displayed value to match that of the standard solution. (The standard solution could be saturated air, approximately 9 ppm.) The probe should be placed in a standard solution and allowed to stabilize.

Once the ADC value stabilizes, for either of the above methods (100% humidity or a given standard solution), press the STORE key to complete the oxygen sensor calibration. If you wish to skip this step, simply press the ENTER key and the previous calibration information will be used.

After the oxygen sensor calibration is complete, the WATER ANALYZER will resume displaying the four measured parameters: temperature, pH, conductivity, and oxygen.

### 6.3 PH SENSOR CALIBRATION

For maximum accuracy, the pH sensor is calibrated at 3 points. Generally one acid point, one base point, and neutral are used.

To calibrate the pH sensor, turn the WATER ANALYZER on and let

the readings stabilize. Then press the MODE key to reach the Mode menu and press either the UP or DOWN arrow key until "Calibrate pH" is displayed. Press the ENTER key to select the Calibrate pH mode.

The top line of the display will now read "pH low cal 4.00". The UP and DOWN arrow keys can be used to adjust this to a different value, if desired. The pH sensor should be completely immersed in the buffer.

The bottom line of the display will show an "ADC" value. When the displayed ADC value stabilizes, press the STORE key to save the calibration information. To skip this step, press the ENTER key and the previous value will be used.

After the pH low cal point has been determined, the pH mid cal and the pH high cal points will be prompted for. We recommend that pH 4, pH 7 and pH 10 buffers be used for calibrating the pH sensor.

While the solutions used are buffers and will remain reasonably stable in pH value, in spite of slight dilution or contamination, the greatest accuracy will be obtained by using fresh, clean buffers. After a solution has been used to calibrate a pH point, it should be discarded.

Once the pH high point has been determined, the meter will resume displaying the measured values for the temperature, conductivity, pH, and oxygen.

#### 6.4 CONDUCTIVITY SENSOR CALIBRATION

The conductivity meter contained within the WATER ANALYZER has four ranges of sensitivity. The WATER ANALYZER automatically selects the appropriate range for displaying the conductivity value. Each range, however, must be calibrated separately. We recommend that all four ranges be calibrated at the same time rather than the single range you may be using.

To calibrate the conductivity sensor, turn the WATER ANALYZER on and press the MODE key to reach the Mode menu. Press either the UP or DOWN arrow key until the "Calibrate Cond" prompt is displayed. Pressing the ENTER key will now select the Calibrate Cond mode.

The top line of the display will then read "Cnd 1 cal 73.9 uS". The UP and DOWN arrow keys may be used to alter this calibrator value to match your standard. Range 1 requires a conductivity standard between 50 and 99 uS/cm for proper

calibration. The conductivity sensor and thermistor should be completely immersed.

When the displayed ADC value stabilizes, press the STORE key to save the calibration information. If you press the ENTER key you will skip the calibration of this conductivity range.

After range 1 has been calibrated or skipped you will be prompted to calibrate each of the other three ranges in a similar fashion. Each range requires a different standard solution. The conductivity of the 2 standard should be between 500 and 990  $\mu\text{S}/\text{cm}$ , standard 3 between 5.0 and 9.9  $\text{mS}/\text{cm}$  and standard 4 between 50 and 99  $\text{mS}/\text{cm}$ . (Conductivity standards provided in the WATER ANALYZER calibration kit are 73.9  $\mu\text{S}$ , 717  $\mu\text{S}$ , 6.66  $\text{mS}$ , and 58.6  $\text{mS}$ .)

Conductivity standards are not buffers. Dilution or contamination will affect their conductivity value. After a solution has been used to calibrate a conductivity range it should be discarded.

After the fourth conductivity range has been calibrated, the meter will resume displaying the measured values for temperature, pH, conductivity, and oxygen.

## 7.0 REVIEW LOG

The Review Log mode allows measurements previously stored in the measurement log to be viewed.

To review the stored readings, press the MODE key to reach the Mode menu and then press either the UP or DOWN arrow key to reach the Review Log prompt. Press the ENTER key to activate the Review Log mode and which allows you to observe the previously stored readings.

The UP and DOWN arrow keys may be used to step through the list of numbered log entries. When all of the log entries of interest have been examined, press the MODE key to return to the Mode menu.

## 8.0 CLEAR LOG

The Clear Log mode allows the measurement log to be emptied. This clears the memory for the next set of readings to be stored. To erase the measurement log, press the MODE key to reach the Mode menu and then press either the UP or DOWN arrow key to reach the Clear Log prompt. Pressing the ENTER key activates the Clear Log mode and allows erasing of the



measurement log.

You will be prompted with the question "Clear Log?". The UP or DOWN arrow key may be used to toggle between the answers Yes and No. If the Yes answer is displayed and the ENTER key pressed the log will be cleared; if the No answer is being displayed, the log will remain untouched.

After the ENTER key has been pressed, the WATER ANALYZER will resume its display of the measured parameters.

## 9.0 RS-232 OPTION

The WATER ANALYZER can be optionally equipped with an RS-232 interface and Time Clock which link the WATER ANALYZER with your personal computer. With this link, parameters which you have read and stored can be downloaded to a file in your computer.

### 9.1 TIMED READINGS (AUTO LOGGING)

Clear the log, using instructions in Section 8.0. Press the MODE key and use the arrows to find "Timed Readings". Pressing the ENTER key should show, "Store 10 minutes", i.e. a set of readings will be taken and stored every 10 minutes. Shorter or longer intervals can be selected by using the arrow keys and pressing STORE to initiate the operation of the timed readings.

Once the STORE key has been depressed, the first reading will be taken immediately. Subsequent readings will be taken at the interval selected. As each reading is taken, a location number will appear momentarily in the middle of the display top line.

Timed Readings may be deferred or the mode terminated at any time by pressing the MODE key twice or by turning the instrument off.

The clock values will be stored but not displayed on the meter. Stored clock values can be seen only via the RS-232 link.

## 9.2 RS-232 Procedure

The WATER ANALYZER is a DCE device, with only Tx and Rx implemented, no other protocol lines are present.

Baud Rate: 1200  
Number of bits: 8  
Parity: none  
Stop bits: 1

No MODEM is needed, the WATER ANALYZER can be connected directly to COM1 or COM2 of your PC with the cable provided.

### HOOK-UP:

Instructions for Transferring Stored Reading from the Water Analyzer to a Computer.

1. Attach the communications cable to the computer's COM1 port and the WATER ANALYZER (If you would rather use the COM2 port, please see the note following step 8.)
2. Insert the Water Analyzer Communications diskette into drive A or B. Log on.
3. Type WATER and press <ENTER>. The WATER communications program will start.
4. Turn the Water Analyzer on.

Key in the following letters and press ENTER to receive information from the Water Analyzer.

A....All data currently displayed on meter.

B....Barometric pressure (on models with internal barometric pressure only).

C....Conductivity reading.

I....Software identification.

O....Oxygen readings.

P....pH reading.

S....Stored data. Use this command to dump stored data into the disk file that you named in step 5.

T....Temperature reading.

5. Type <ALT S>, the program will prompt you to specify the name of your Save file.
6. Type <S><ENTER>. The Stored Readings will begin to be displayed on the screen within 10 seconds. If there are no stored readings, there will be message telling you this.
7. When the Stored Readings have been displayed, type <Alt S> to close your Save file.
8. The WATER program may be terminated by typing <Alt X>.

Note: To change from the COM1 port to the COM2 port, follow these steps once the communications program WATER has been evoked:

- a. Type <Alt C>. The highlighted line at the bottom of your screen will prompt for the new entry.
- b. Type <2><ENTER>.
- c. The COM2 port will now be used to transfer the stored readings. This needs to be done only once and can be changed back to COM1 at anytime.

## 10.0 SENSOR MAINTENANCE

The WATER ANALYZER normally requires only minimal maintenance, aside from periodic calibration. The frequency of required calibration will depend upon the accuracy of the readings desired, the frequency and manner in which the meter is used, and the storage conditions.

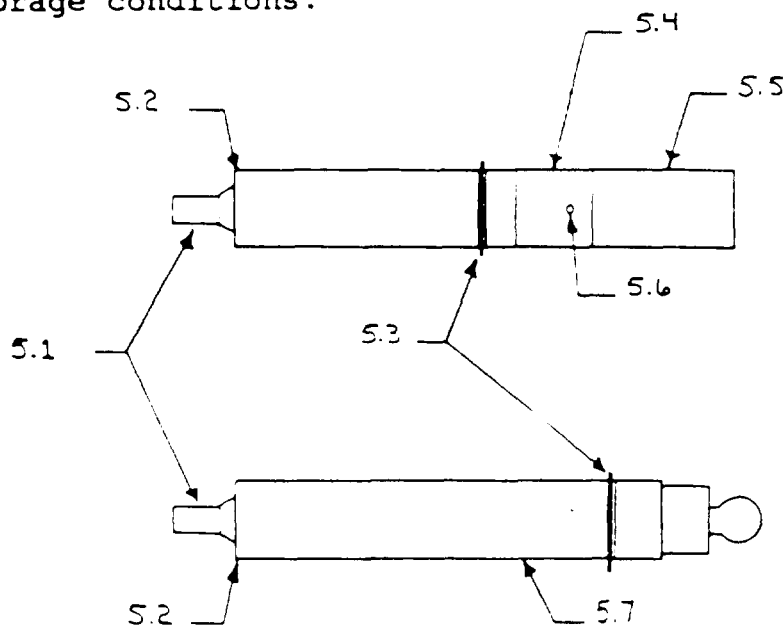


Figure 5

To remove a sensor (pH or oxygen), for service, first remove the probe guard, then firmly pull the sensor straight out from the probe body. Do not use any tools to pry the sensor out as this may damage the sensors. Disconnect the sensor and be sure the connector (see 5.1, Figure 5) remains outside the probe body for easy sensor re-connection. Once removed the sensor can be cleaned or replaced if needed.

**WHEN A SENSOR IS OUT OF THE PROBE -  
DO NOT PUT THE PROBE IN ANY WATER.**

Placing the probe in water at this time will destroy the electronics within the probe and invalidate your warranty. When replacing a sensor in the probe, silicone grease (included with your meter), needs to be applied to the connector end of the sensor body (see 5.2, Figure 5). Apply a drop of silicone to the edge of the sensor body. (See NOTE below.) Insert the sensor by pushing and twisting 360°, until the retainer ring is in place (see 5.3, Figure 5). This will insure that the entire outer circumference of the sensor has silicone on it. The silicone increases the O-ring water tightness ability.

**NOTE: DO NOT ALLOW SILICONE GREASE TO GET ON THE CONNECTORS.** If any silicone grease gets on the connectors, clean it off with alcohol. The silicone acts as a barrier and will interfere with the sensor/probe communication.

## 10.1 OXYGEN SENSOR

If the sensitivity of the oxygen sensor decreases, it may be necessary to clean the sensor or replace the oxygen membrane.

To perform either step it is first necessary to remove the oxygen sensor from the probe (see Section 10.0) and then remove the membrane. Unscrew the filling solution cavity (see 5.4, Figure 5) and discard the solution. The cavity section in your hand consists of two sections. Unscrewing the lower section (see 5.5, Figure 5.5) will release the membrane. Use tweezers to pull the membrane out. The used membrane should be discarded.

Using tweezers, carefully center a new membrane (Section 4.2, Figures 3 & 4) over the end of the larger section. Twist the smaller section (see 5.5, Figure 5) back on, tightly. A package containing additional membranes was included with your meter. Additional membranes are available from your dealer.

The cathode and anode of the electrode can be cleaned with alcohol. Rinsed with deionized water, followed by a rinse with the oxygen electrode filling solution. Fill the cavity

with filling solution (1.5 M KCl/glycerol solution) and insert sensor tip. Screw cavity (see 5.4, Figure 5) back onto the sensor. Excess filling solution will squirt out of a hole on the side of the cavity (see 5.6, Figure 5).

**DO NOT ALLOW ANY OXYGEN FILLING SOLUTION TO GET ON THE SENSOR CONNECTOR.**

If filling solution does get on the connector, immediately clean the connector off with alcohol and wipe dry. You may have to rub alcohol on the connector to remove all the glycerol.

Apply silicone grease to the connector end of sensor body (see Section 10.0).

**DO NOT ALLOW ANY SILICONE TO GET ON THE MEMBRANE.**

Any grease on the membrane will clog the membrane pores, resulting in the oxygen sensor not working properly. Replace sensor in the probe.

After the membrane has been replaced, the oxygen sensor should be allowed to standardize. Immerse the probe in air saturated distilled water or in a plastic bag with a few drops of water or a wet sponge or cloth, for approximately 20 minutes. Recalibrate sensor prior to use.

## 10.2 CONDUCTIVITY AND TEMPERATURE SENSORS

DO NOT ATTEMPT TO REMOVE THE CONDUCTIVITY OR TEMPERATURE SENSORS. The conductivity and temperature sensors are secured internally (see Figure 6) and can only be removed at the factory. Removal will invalidate the probe warranty. Should the conductivity or temperature sensor need to be replaced, send the probe and meter back to your dealer or the factory.

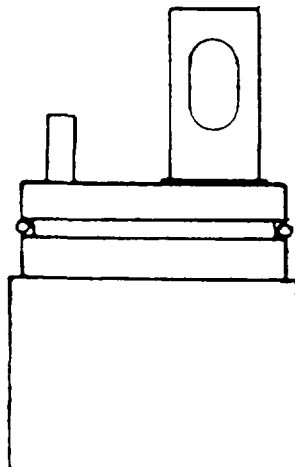


Figure 6

The conductivity sensor requires only minimal maintenance. The sensor element is made of graphite and resistant to most chemicals. The thermistor is housed in stainless steel and is also resistant to most chemicals.

Rinse the sensors in clean water after each use. These sensors can be stored dry.

Should any build-up become evident the sensors should be cleaned. A mild soap detergent, with some agitation, is usually sufficient to effectively remove most deposits. Rinse and recalibrate.

### 10.3 pH ELECTRODE

The pH electrode (see 5.7, Figure 5) requires more maintenance than any of the other sensors used by the WATER ANALYZER.

The pH electrode (see Figure 5.8) must not be allowed to dry out. A boot has been provided with the WATER ANALYZER to keep the electrode moist. It should be filled with pH electrode boot solution (10% KCl in pH 4 buffer) and kept on the electrode when not in use. The boot should be removed prior to use or both the conductivity and pH readings will be in error.

The pH electrode must not be stored dry. If the electrode is allowed to dry, it will be rendered useless and the sensor will have to be replaced or returned to the factory for repair.

Storing the pH electrode in deionized water (or any solution lacking sufficient KCl) will cause the electrode to drift and require increasingly frequent calibration.

### 10.4 PROBE STORAGE

For short term storage (overnight or over a weekend), place the boot, with boot solution, on the pH sensor. Then place the entire probe in a plastic bag with a damp sponge or cloth and secure the bag, so that a humid environment is maintained. Or immerse the probe in deionized water (with the pH boot on).

Long term storage requires a few extra steps. Turn the meter off. If the meter is to be charged during storage, disconnect the probe from the meter. The pH sensor should be stored with the boot, containing boot solution. The oxygen sensor should be disconnected and disassembled. All parts should be rinsed and blotted dry. The oxygen sensor can then be reconnected to the probe.

## 11.0 TROUBLESHOOTING

The WATER ANALYZER is not designed for field repair. Some problems, however, may be remedied without the need for any physical disassembly. The more common of these and their remedies are listed below. If you have a more serious problem or the listed remedy seems ineffectual, contact your dealer or the factory for additional help.

PROBLEM	SUGGESTED ACTION
No display	Battery not charged. Check for operation with the AC adapter. If necessary, recharge the battery by leaving the WATER ANALYZER plugged in overnight.
Displays <<< or >>>	The symbol <<< is used to indicate underrange (too small a value) and >>> overrange (too large a value). For conductivity, <<< indicates the solution has a conductivity of less than 10 uS/cm; >>> a conductivity greater than 99.9 mS/cm. If this appears unexpectedly it may indicate a problem with the probe. You may wish to service the appropriate sensor as described in section 9.
Displayed value is incorrect	Check the calibration of the appropriate sensor. When is re-calibration is necessary, press the STORE key to save the calibration information.
pH will only read 0 or 14	If the pH reading remains at 0 or 14 even after calibration, the probe may be leaking. Remove the sensor and check for water drops and dry. Re-insert sensor as described in Section 10.0.
pH drifts	If the pH reading drifts or you are unable to obtain a constant ADC value, when calibrating the pH sensor, the pH electrode has probably been stored improperly. Soak the pH sensor in warm (40°C) water saturated with KCl for several hours. Then soak the sensor overnight in 10% KCl in pH 4 buffer. (Be sure to remove the boot from the pH sensor before performing this procedure.) Normal storage of the pH electrode is with the boot in place and filled with 10% KCl in pH 4 buffer.

Conductivity  
readings drift

If the conductivity readings drift or are in error, use the procedure described in section 10.2 to clean the conductivity sensor. Be sure to calibrate the conductivity sensor after cleaning it.

Please contact your dealer or the factory for any problems which continue to exist or are not described in the above guide.



## 12.0 SPECIFICATIONS

<u>SENSOR</u>	<u>UNIT</u>	<u>RESOLUTION</u>	<u>RANGE</u>	<u>ACCURACY</u>	<u>COMPENSATION</u>
pH:	pH	.01	1-13	.02	TEMP (AUTO)
	mV	1	± 500	± 2%	NONE
TEMP:	°C	.1°	0-50	1	NONE
	°F	.1°	32-122	1.8	NONE
COND:	MHOS	.1 umho	0-99.9	± 3% <sup>1</sup>	TEMP (AUTO) (20 or 25°C) OR NONE
		1 umho	0-999	± 3%	
		.01 mmho	0-9.99	± 3%	
		.1 mmho	0-99.9	± 3%	
<sup>1</sup> MINIMUM SIGNAL IS 10 umhos					
	SIEMANS	.1 uS	0-99.9	± 3% <sup>2</sup>	TEMP, AUTO (20 or 25°C) OR NONE
		1 uS	0-999	± 3%	
		.01 mS	0-9.99	± 3%	
		.1 mS	0-99.9	± 3%	
<sup>2</sup> MINIMUM SIGNAL IS 10 uS					
TDS		.1 ppm	0-49.8	± 3% <sup>3</sup>	TEMP, AUTO (20 or 25°C) OR NONE
		1 ppm	0-498	± 3%	
		.01 ppt	0-4.98	± 3%	
		.1 ppt	0-49.8	± 3%	
<sup>3</sup> MINIMUM SIGNAL IS 5 ppm					
OXYGEN:	ppm	.1 ppm	0-20.0	± 2 TO 5% <sup>4</sup>	TEMP, AUTO SALINITY, OPT.
	mg/L	.1 mg/L	0-20.0	± 2 TO 5% <sup>4</sup>	TEMP, AUTO SALINITY, OPT.
	%SAT	.1 %	150.0 % sat	± 2 TO 5% <sup>4</sup>	TEMP,AUTO SALINITY, OPT. PRESS, AUTO

<sup>4</sup> ± 2% within 5°C of calibration temperature, ± 5% from 0 - 35°C.

**BAROM:** The accuracy given here is for meters with factory installed pressure sensors.

torr	1 mm Hg	400 - 1000 mm Hg
in Hg	.1 in Hg	15.8 - 39.3 in Hg

Meters without pressure sensors can make the necessary compensation by entering the pressure manually.

**DATA STORAGE:** The Water Analyzer stores 199 sets of readings. A log number is assigned when the storage button is pressed, and displayed when readings are being reviewed.

**DATA REVIEW:** Stored readings can be reviewed in REVIEW LOG mode.

**DISPLAY:** 2 x 16 LCD

**BATTERY:** 6 Volt Rechargeable Sealed Lead Acid

**DISCHARGE TIME:** 8 Hrs. Low battery indicator and automatic shutoff to prevent calibration and stored reading memory loss.

**RECHARGE TIME:** 15 Hrs. Can be charged continuously

**OPERATION TEMPERATURE:** 0-40°C (meter)  
0-50°C (probe)

**STORAGE TEMPERATURE:** 5-40°C

**PROBE DIMENSIONS:** 12" x 1.5" (LxD)

**METER DIMENSIONS:** 7.5" x 4.25" x 1.5" (LxWxD)

**SHIPPING WEIGHT:** 5 lbs

#### OPTIONAL RS-232 OUTPUT

**RS-232 OUTPUT:** Stored readings can be transferred to IBM compatible or Macintosh computers. Output is 1200 baud. Communication software and cable are provided. Output is in ASCII format.

**AUTO LOGGING:** Readings are automatically stored at set intervals from 1 to 59 minutes.

## LIMITED ONE YEAR WARRANTY

### What the manufacturer will do:

This product (except for the sensors) is warranted by the manufacturer against defects in materials and workmanship affecting the electronic and mechanical performance for one year from the date of original purchase. During the warranty period the manufacturer will repair or, at their option, replace, at no charge, a product that proves to be defective, provided the product is returned, shipping prepaid to a service center.

### What is not covered:

The sensors are not covered by this warranty. This warranty does not apply if the product has been damaged by accident or as the result of service or modification by other than an authorized service center. No other express warranty is given. Repair or replacement of the product is your exclusive remedy. In no event shall the manufacturer be liable for consequential damages.

## **GEO GROUP INFRA-RED GA-90 ANALYZER**

# **Operating Manual**

**Geo Group  
Infra-Red Analyzer  
(Part Number: GA90)**



**1-800-332-0435**



# **Operating Manual**

## **Infra-red Gas Analyzer**

**Geo Group Inc. Version**

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## Warning

The Geo Group Inc. GA 1.1 Gas Analyzer Unit is not yet certified to any recognised safety standard - it therefore is NOT classified as intrinsically safe.

The Readout must NOT be used in confined areas (e.g. basements, mines, sewers, manholes, enclosed buildings, etc... ) or any area that could be considered potentially hazardous.

It is vital that this instruction be followed absolutely, since any instrument which is not classified as intrinsically safe could cause an explosion resulting in serious injury or death.

The appropriate certification approval is being sought and it is envisaged that later models will be classified as intrinsically safe.

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## Introduction - General

The Infra-Red Gas Analyzer has been designed to obtain accurate data on the concentrations of the main constituents of Landfill gas - Methane, Carbon Dioxide and Oxygen. In addition, an electronic pressure transducer can be fitted in order to measure atmospheric pressure at the time of analyzing a gas sample. The atmospheric pressure can be measured in two modes - as absolute pressure and as pressure relative to a fixed datum. The Methane reading can be auto-zeroed within the calibrated limits.

The unit is capable of storing 1200 sets of readings (1 set = 3 gas concentrations plus atmospheric pressure) together with the date and time that they were obtained. Facilities for viewing and deleting readings are also provided. Readings may be downloaded to an IBM or compatible computer via an integral RS232C interface. The unit can also be used as an independent data logger.

The outer case is constructed from moulded glass reinforced plastic, making the unit light but robust. It is environmentally sealed and may be used in severe weather conditions.

The Infra-Red Gas Analyzer has been developed with the user very much in mind. The membrane switch panel has audio feedback and a series of menus are presented to the operator - thus permitting interaction with ease.

The unit is also fitted with an automatic power-off device in order to conserve power. Thus if no key is pressed for 15 minutes then the unit will automatically switch itself off (no stored readings will be lost).

The unit is supplied complete with the following accessories -

Carrying Strap

Sampling Probe

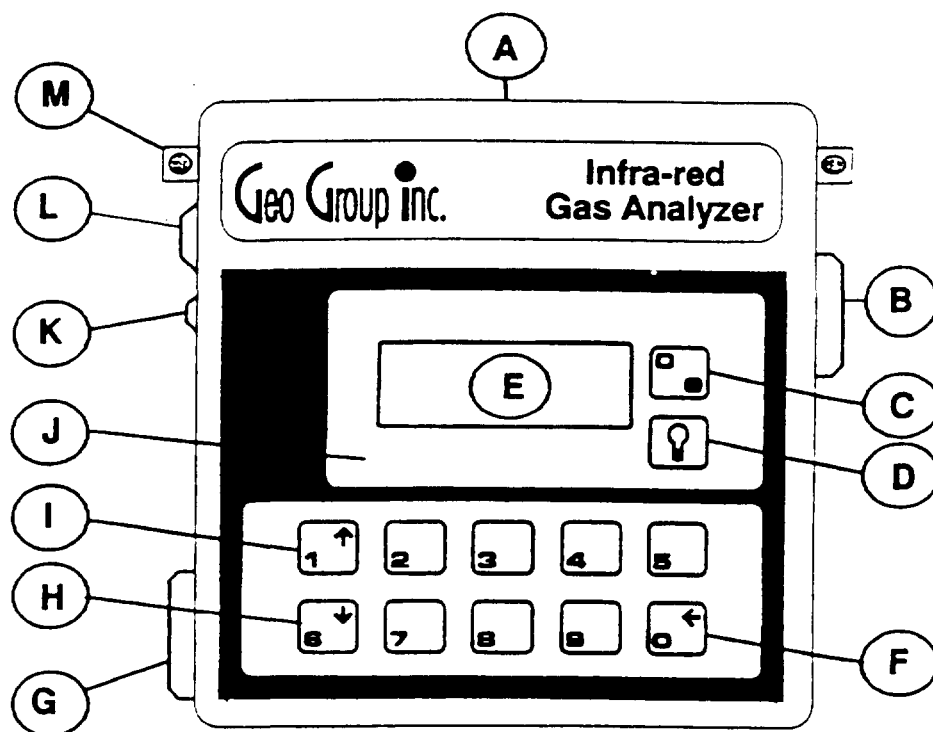
1m (3ft) of Sampling Tube

In line Water Trap with Spare Filter

Spare Inlet Filter

Battery Charger and Lead

Operating Manual



## Infra-red Gas Analyzer

- A - GRP Outer case
- B - Inlet port and replaceable filter
- C - On/Off key
- D - Backlight key (Not operational)
- E - Graphic LCD
- F - Exit key - press once. Rubout key - keep pressed
- G - Exhaust port
- H - Cursor down
- I - Cursor up
- J - Membrane panel
- K - 4 pin charging socket
- L - 7 pin RS232C socket
- M - Carrying strap attachments

## Maintenance

### Operating Manual

Although the Infra-Red Gas Analyzer is very easy to control, we strongly recommend that this Operating Manual is read prior to use.

### Servicing

The unit will have been electronically and functionally tested before it leaves our factory and in order to keep the unit in perfect working order we recommend that it is returned to us at six monthly intervals for routine servicing, maintenance and calibration.

### Cleaning

The polycarbonate membrane panel may be wiped clean with soapy water and a damp cloth if required. We do not recommend any other cleaning agents.

### Sunlight

The unit should not be left out in direct sunlight for long periods of time as this will raise the temperature inside the case which could cause damage to components.

### Dustcaps

Always replace the protective dust caps on the sockets and on any leads.

### Filter

It is important that the replaceable filter (fitted inside the inlet port) is regularly changed. It should be replaced -

If the aspirator pump has difficulty in drawing a sample of gas into the unit (indicated by an continuous warning note and a Flow Fail message on the screen).

If the filter has been allowed to become wet (also maybe indicated by an audible warning note and Flow Fail indicator).

**The filter is changed as follows -**

Remove the Sampling Tube from the Gas Analyzer by carefully pulling the tube from the Inlet nozzle.

The filter inlet nozzle is removed by inserting a suitable coin in the groove cut into the nozzle end and turning in an anti-clockwise direction. When the nozzle is removed, the old filter will be attached to the rear of the nozzle. This filter can be removed by using your fingers.

Carefully locate a new filter onto the rear of the nozzle, ensuring it is firmly located. It is important that only genuine Geo Group Inc. filters are used with the Gas Analyzer or the performance and safety of the unit may be at risk. When the new filter is in position, carefully replace the nozzle in the Gas Analyzer and using the coin in the groove, turn until it is finger tight.

### Storage

If the unit is to be stored for a long period, the internal batteries should be fully charged prior to storage and then checked and charged every 2 months during storage. **Failure to do this may cause damage to the batteries**

### Important

Although the Infra-Red Gas Analyzer is housed in a rugged environmentally sealed case, it must be noted that it is an advanced scientific instrument and should be treated as such.

**Battery Charging**

Please follow these instructions carefully

The internal battery of the Infra-red Gas Analyzer is comprised of a series of Nickel-Cadmium cells with a maximum output of 8.4volts D.C.

It must only be charged with a Geo Group Inc. Battery Charger (provided with the unit).

It is important that the battery is not overcharged, as this could result in damage to one or more of the cells.

There is a linear relationship between battery capacity used and the required charging time. Reference to paragraph 1.2.1 of this Manual shows how to determine the available battery capacity.

The following table should be used as a guide (see Battery Capacity, below).

Available Capacity without pump (see Paragraph 1.2.1)	Maximum Charging Time
6.6 hours	Nil hours
6.0	2.0
5.0	4.0
4.0	6.0
3.0	8.0
2.0	10.0
1.0	12.0
0.0	14.0

Note: The above Table applies to all Gas Analyzers with  
"supply = 100" marked on their serial number plate.

**Battery Capacity**

If the readout unit is repeatedly given small "top-up" charges, the battery capacity can be reduced resulting in an incorrect available capacity display. To restore the battery to full capacity, totally discharge the unit and then charge for a full 14 hour period.

**Battery Charger**

The battery charger is fitted with two lights -

**Red/orange Neon** - indicates the mains power is on.

**Green L.E.D.** - indicates that charging is in process.

Note this light will not diminish with charging time and is not to be used as an indication of the charge state of the Gas Analyzer.

The green light will only go out if the 4 pin connector is removed from the Gas Analyzer when the mains supply is on. Thus it is important to be aware of the exact charging time required and avoid leaving the charger and Gas Analyzer connected for excessive periods.

**Battery Shut-off**

A circuit within the Gas Analyzer continuously monitors the battery voltage. If the battery voltage falls below a pre-determined level the unit will automatically shut itself off in order to prevent memory loss. If the unit shuts itself off when the battery display shows capacity still available, then the unit requires a full charge of 14 hours to restore the battery to its maximum level.

**Automatic Power-off**

The unit is also fitted with an automatic power-off device in order to conserve power. Thus if no key is pressed for 15 minutes then the unit will automatically switch itself off (no stored readings will be lost).

### Calibration Check

It is important to check the accuracy of the Gas Analyzer periodically in order to ensure continued reliability. To perform a Calibration Check you will need -

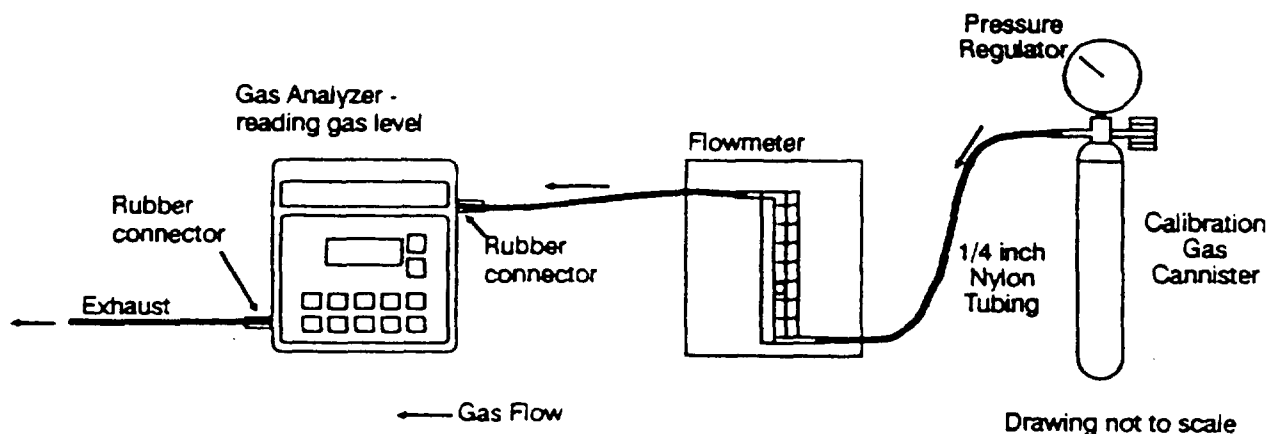
### Equipment

1. A cannister of Calibration Gas fitted with a pressure regulator capable of regulating in the range 0 - 10psi. This is a pre-prepared mixture of gases, of which the important constituents are Methane and Carbon Dioxide at known percentages. The cannister must be fitted with suitable connectors for the 1/4inch nylon tubing.
2. A Flowmeter, capable of measuring in the range 60 - 600cc per minute maximum and fitted with suitable connectors for the 1/4inch nylon tubing.
3. Three 24inch lengths of 1/4inch Type 11 nylon tubing.
4. Two 2inch long rubber tubing connectors, 3/16inch I.D. x 1/8inch wall thickness, for connecting the nylon tubing to the inlet and exhaust ports of the Gas Analyzer.

All this equipment is available from Geo Group Inc. Other types of tubing can be used but the connections must be airtight and secure.

### Calibration Procedure

1. Connect the Calibration Gas cannister to the flowmeter and the flowmeter to the gas Analyser using two lengths of the 1/4inch nylon tubing. The third length of nylon tubing is to provide an exhaust outlet for the Calibration Gases. The two 2inch lengths of rubber tubing are to push onto the inlet and exhaust nozzles of the analyser and then insert the nylon tubing inside the rubber tubing for a secure connection. This diagram shows the arrangement -



2. Prior to flowing any gas the readout unit must be auto-zeroed as described in section 1.3.
  3. Allow the Calibration Gas to flow into the sampling chamber at a rate of no more than 300cc per minute maximum and at a maximum pressure of 5psi.
  4. Switch on the Gas Analyzer and follow the Read Gas Level operation (see Section 2, page 22), but do not use the pump facility to draw the calibration gas into the analyser or the calibration check will be inaccurate.
- When the display has stabilised the readings should correspond to the known percentages of the Calibration Gas within the tolerances given in the table below.

**IMPORTANT SAFETY PROCEDURES:** The Calibration Gas used must be a Regulated Supply with a restricted flow rate of 300cc per minute maximum. Always use a low pressure of less than 5p.s.i. No high pressures are to be used.

The exhaust tubing must emerge in a well vented area. Ensure there are no leaks in the tubing and connections otherwise explosive gas concentrations could occur.

No naked lights and No Smoking are allowed in the area of calibration testing.

If the readings do not generally correspond with the Calibration Gas percentages, within the tolerances, then the Gas Analyzer should be returned to Geo Group Inc. for re-calibration.

Concentration	Typical Accuracy		
	CH <sub>4</sub> % by Volume	CO <sub>2</sub> % by Volume	O <sub>2</sub> % by Volume
0-5% (LEL CH <sub>4</sub> )	± 0.5%	± 0.5%	± 1.0%
5-15% (UEL CH <sub>4</sub> )	± 1.0%	± 1.0%	± 1.0%
15-100% (30% Max. O <sub>2</sub> )	± 3.0%	± 3.0%	± 1.0%

**Note:** If a Barometric Sensor option is not fitted then an additional error of 1.0% of reading, per 10 mbar difference, between original calibration pressure and the pressure during checking could be obtained.

## Starting Up

Switch on at the Gas Analyzer by pressing the red key ("C" on the illustration, page 5). The Warning Display will appear thus -

**WARNING!-Do NOT use  
in confined spaces.  
-Unit NOT certified  
intrinsically safe.**

The Gas Analyzer is not yet certified to any approved safety standards, therefore it is NOT classified as intrinsically safe. The Readout must not be used in confined areas (e.g. basements, mines, sewers, manholes, enclosed buildings, etc...) or any area that could be considered potentially hazardous.

It is vital that this instruction be followed absolutely, since any instrument which is not classified as intrinsically safe could cause an explosion resulting in serious injury or death.

The appropriate certification approval is being sought and it is envisaged that later models will be classified as intrinsically safe.

After 5 seconds, the Warning Display will be replaced by the Title Display -

**Geo Group Inc.  
I-R Gas Analyzer  
1/6-Contrast 0 - Exit**

Display contrast can now be adjusted as follows.

Press key 1 to increase contrast and press key 6 to decrease contrast.

The new setting of contrast will remain in the memory of the unit, even when it is switched off. When the desired level of contrast has been selected press key 0 to continue. When key 0 is pressed, the **Main Menu** will appear.

**1-General Utilities  
2-Read Gas Levels  
3-View/Print Data  
4-Download Data**

The main purposes of each of the options are as follows.

### 1. General Utilities

This option allows the operator to -  
check that the internal clock is operating correctly  
check that the battery is charged  
check that the alarm levels are set as required  
auto-zero the methane reading  
set the atmospheric pressure reading mode to absolute or relative  
check that there is sufficient storage capacity available in memory.

**2. Read gas Levels**

Allows the operator to obtain and store readings of gas concentrations. Also allows control of data logging functions (where option is fitted).

**3. View/Print Data**

Allows scanning of all readings stored in the memory and also enables hard copies to be printed.

**4. Download Data**

Enables stored readings to be downloaded to any IBM or compatible computer for archiving and processing.



## 1. General Utilities

This part of the manual describes how to enter pre-set information which will be stored in the memory of the Gas Analyzer. It also indicates how to check the status of the battery and the memory.  
From the **Main Menu**

**1-General Utilities  
2-Read Gas Levels  
3-View/Print Data  
4-Download Data**

Press **key 1** to reveal the first part of the **General Utilities Menu** thus -

**1-Check Time/Date  
2-Battery Status  
3-Gas Alarm/Zero  
9-More                      0 - Exit**

Pressing **Key 9** will reveal the second part of the **General Utilities Menu** thus -

**4-Memory  
5-Absolute Pressure  
6-Relative Pressure  
9-More                      0 - Exit**

### 1.1 Check Time/Date

- 1.1.1 The gas sampler contains a real time clock and calendar which is powered by an internal secondary battery pack. These functions are maintained even when the unit is switched off.

When readings are stored, then the time and date will also be stored automatically. Both the clock and calendar are preset to U.K. time during manufacture. We advise that you check that the settings correspond with local time prior to use as follows -

**09:15 11/25/90  
1-Set New Time/Date  
0 - Exit**

- 1.1.2 From the **General Utilities Menu**, press **key 1**. The screen will then display the current time and date -

- 1.1.3 If the time and date are correct, press **key 0** to return to the **General Utilities Menu**.

- 1.1.4 If they require resetting, press key 1. The following screen will appear

? : / /

**Enter New Time/Date**

- 1.1.5 The new time and date should be entered as prompted by the question mark in the format.

Hours:Minutes Months/Days/Years

Use two digits for each part of the entry (e.g. 08 = August) and make use of the rubout key (key 0, keep it pressed) to correct any errors.

- 1.1.6 If an attempt is made to enter an impossible time/date, it will not be accepted and the complete entry must be recommenced.
- 1.1.7 When the complete time/date has been entered, the message 0 - Exit will appear on the screen thus -

**09:18 11/25/90**

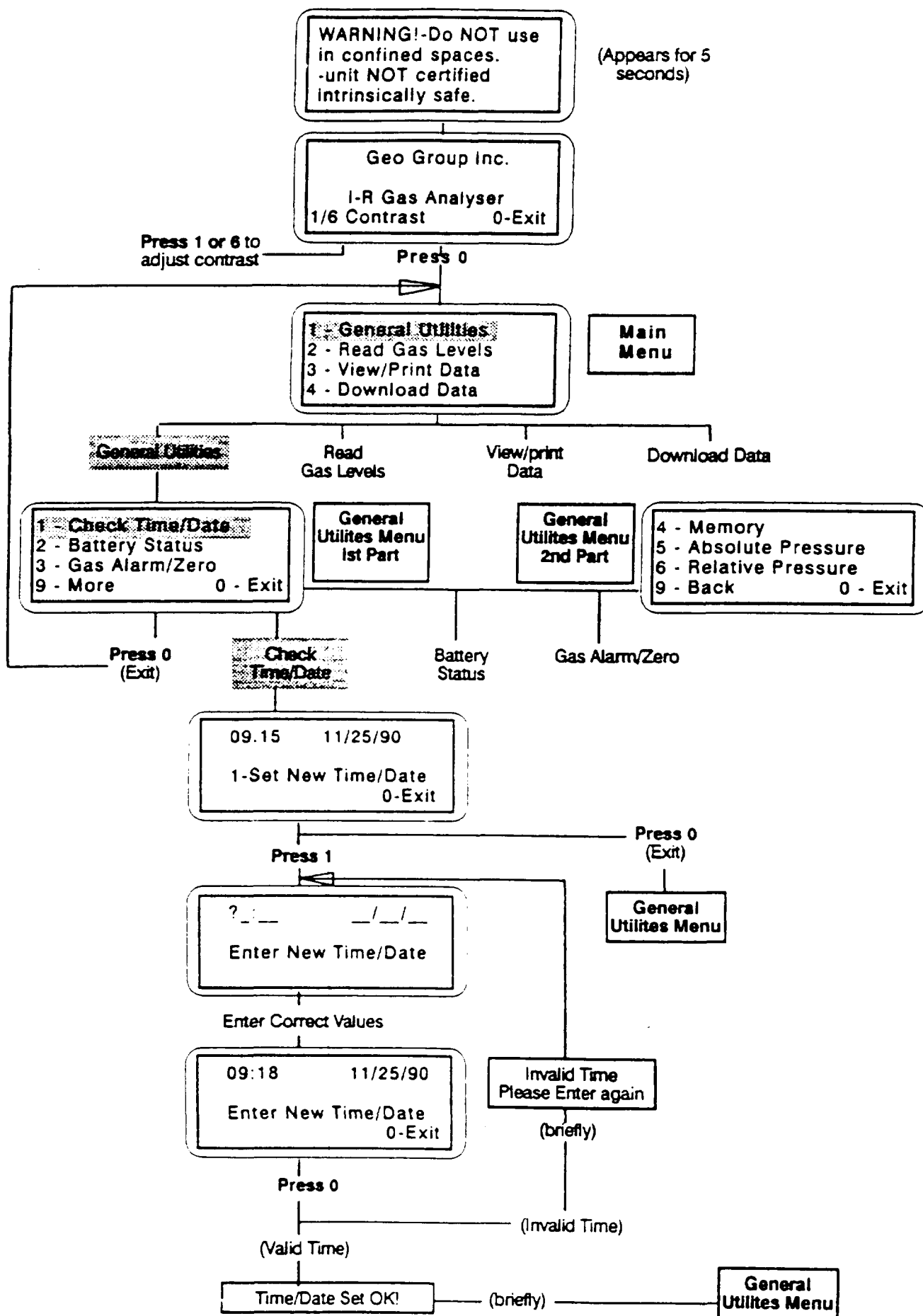
**1-Set New Time/Date**

**0 - Exit**

- 1.1.8 Now press key 0 and the message

Time/Date Set OK!

will appear briefly, prior to the General Utilities Menu being redisplayed.



## 1.2 Battery Status

1.2.1 From the **General Utilities Menu**, select key 2 (**Battery Status**). The following screen will appear -

**Available Capacity**  
**4.0 hrs without pump**  
**3.0 hrs with pump**  
**0 - Exit**


1.2.2 The Gas Analyzer is powered by an internal rechargeable 8.4volt Nickel-Cadmium battery. This is sufficient to provide power for approximately

**6.6 hours without use of the aspirator pump**


**5.0 hours if the pump is used normally.**

A counting device monitors the charge state of the battery and interprets this information to give time estimates of the available battery capacity with and without use of the aspirator.

1.2.3 If key 0 is pressed, the operator will be returned to the **General Utilities Menu**.

1.2.4 When the available battery capacity has dropped to 10% of a full charge, a battery low symbol  will appear at the top right hand corner of the screen, irrespective of the display at that time.

For example, if the **Main Menu** was being displayed, the screen would change to -

**1-General Utili**   
**2-Read Gas Levels**  
**3-View/Print Data**  
**4-Download Data**

1.2.5 When this symbol first appears, battery capacity will be sufficient to operate the unit for approximately

**30 mins without using the pump**

**20 mins with normal use of pump.**

It is therefore imperative that the battery is recharged as soon as possible.

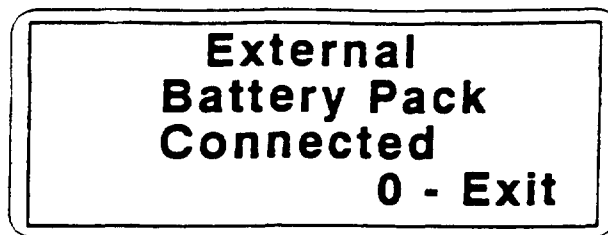
1.2.6 The unit is charged via a 4 pin socket on the left-hand side of the case. Only Geo Group Inc. chargers should be used with the Gas Analyzer.

1.2.7 Please ensure that **Battery Charging Instructions** (given on page 7) are followed very carefully. It is vital that overcharging is not allowed to occur.

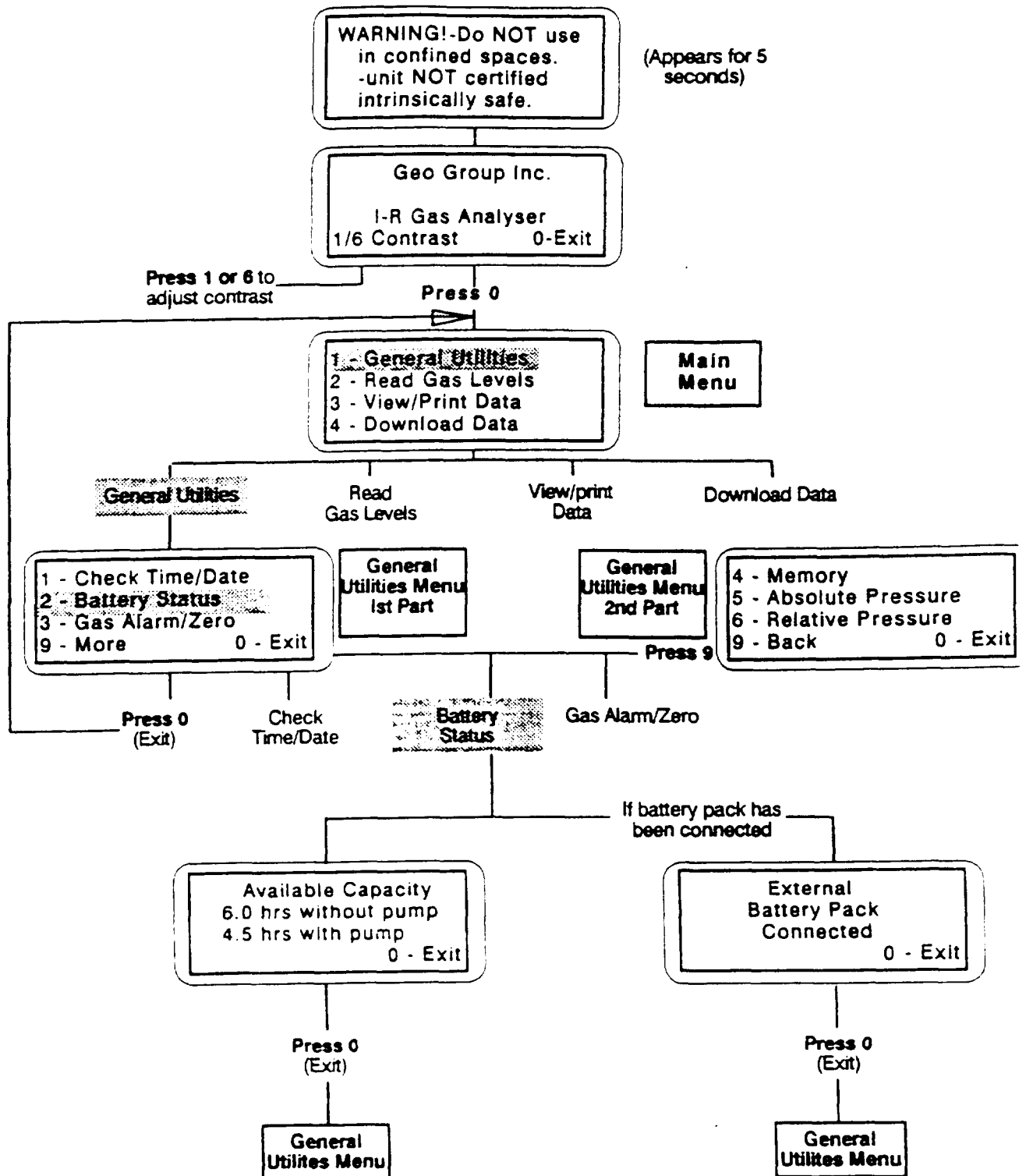
1.2.8 Please note that the Gas Analyzer is fitted with an Automatic Power-off device in order to conserve power. Thus if no key is pressed for 15 minutes, the unit will automatically switch itself off (no stored readings will be lost if this occurs).

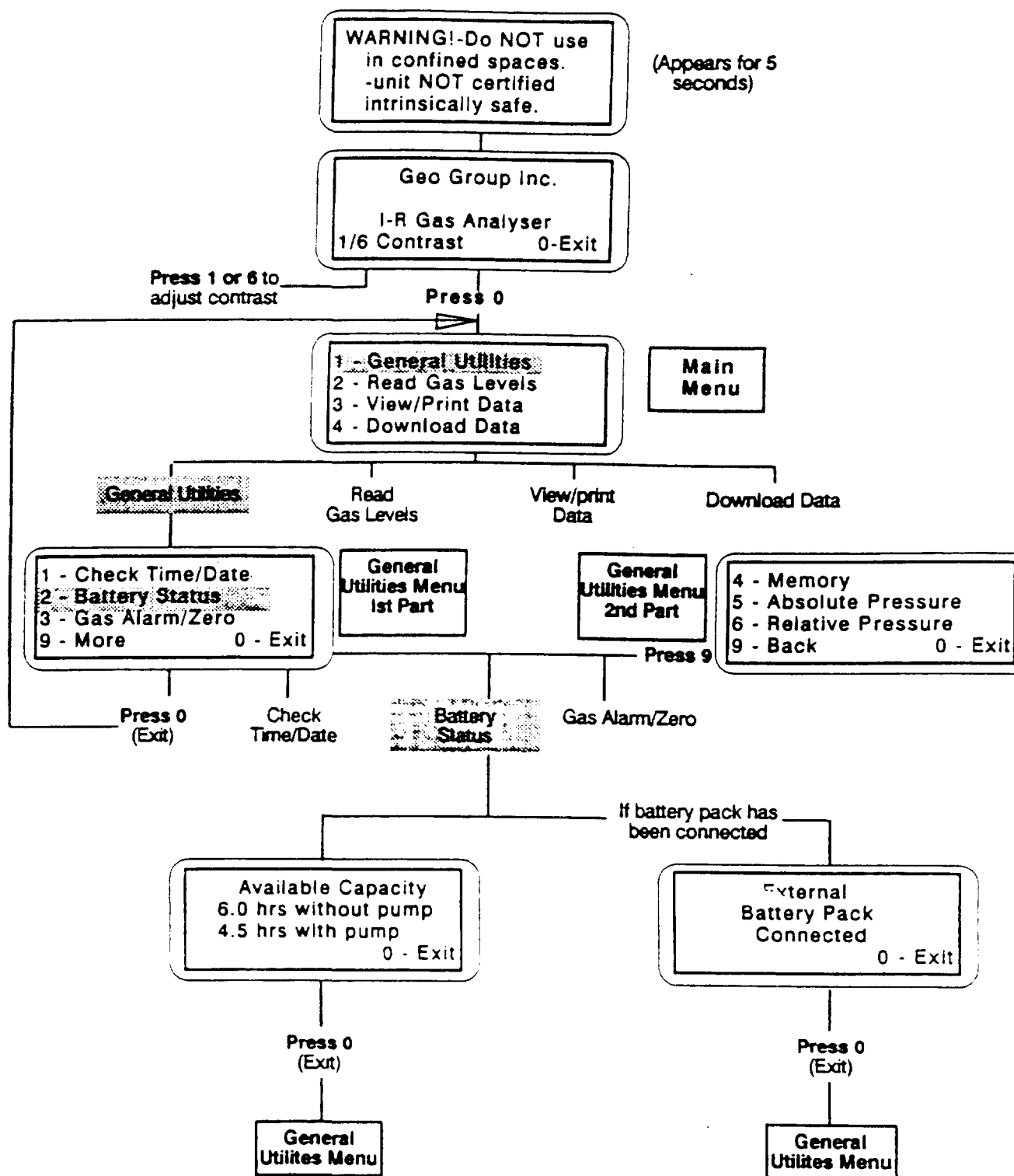
1.2.9 If an external Battery Pack has been connected to the charging socket of the unit, the appearance of the screen shown in paragraph 1.2.1 will be prevented.

In this case, if key 2 (Battery Status) is selected from the General Utilities menu then this screen will be displayed.



Again, pressing key 0 - Exit will return the operator to the General Utilities Menu.





### 1.3 Gas Alarm/Zero

This facility has two sub-options -

1. **Set Alarm Levels.** The Analyzer can warn the operator if a gas sample contains concentrations of Methane, Carbon Dioxide **above** preset levels, or Oxygen **below** preset levels.
2. **Zero CH<sub>4</sub>.** The operator can set the Analyzer's Methane channel to zero before taking readings.

1.3.1 When key 3 is pressed from the General Utilities Menu this screen will appear -

<b>1-Set Alarm Levels</b>
<b>2-Zero CH<sub>4</sub></b>
<b>0-Exit</b>

1.3.2 **Set Alarm Levels.**

The pre-set alarm levels will be displayed if key 1 is pressed from this Menu, thus -

<b>1-Methane</b>	<b>04.0%</b>
<b>2-Carbon Dioxide</b>	<b>15.0%</b>
<b>3-Oxygen</b>	<b>20.0%</b>
<b>1/2/3/-Change</b>	<b>0-Exit</b>

1.3.3 If a sample of gas contains a concentration of Methane/Carbon Dioxide **above** any of these preset values or Oxygen **below** the preset level then the unit will emit an intermittent warning note. The warning note will cease when concentrations fall within current alarm levels. If the alarm levels are satisfactory, pressing key 0 will return the operator to the **General Utilities Menu**.

1.3.4 To change any of the existing alarm levels -

press key 1 for Methane, key 2 for Carbon Dioxide, key 3 for Oxygen.

If for example, key 1 has been pressed, the following screen will appear.

<b>CH<sub>4</sub> Level is 04.0%</b>
<b>Level Required ? . %</b>
<b>Enter Level</b>

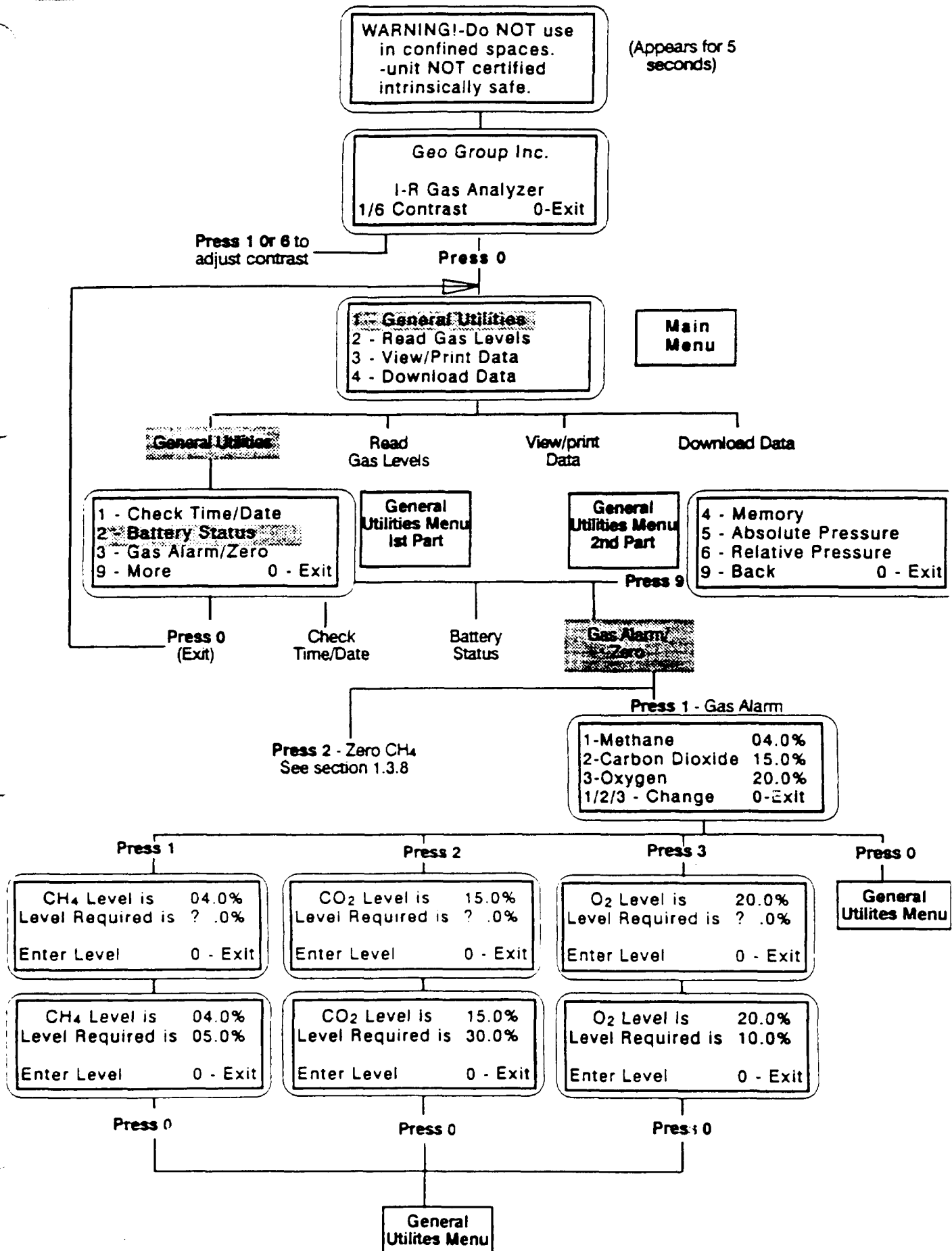
The operator is now being asked to enter the new level required as prompted by the question mark.  
The rubout key (key 0, keep it pressed) may be used to correct any mistakes. The new level must be entered in the format **xx.x%**.



- 1.3.5 When the new level has been correctly entered, the screen will change to -

**CH<sub>4</sub> Level is 04.0%**  
**Level Required 05.0%**  
**0 - Exit**

- 1.3.6 If key 0 is now pressed, the operator will be returned to the General Utilities Menu.
- 1.3.7 Any of the alarm levels may be altered at any time in this manner.



### 1.3.8. Zero CH<sub>4</sub>

The Analyzer should have its Methane zero level checked, and be auto-zeroed if necessary, prior to taking readings at the start of each day. It is not practical to attempt to auto-zero the CO<sub>2</sub> channel because a Nitrogen calibration gas would need to be flushed through the Analyzer for a prolonged period prior to zeroing.

Please note that the normal Read Gas Levels Screen as shown in section 2.1 will not display negative readings, it will display "00.0", however the auto-zero screen will display a negative reading. Therefore it is important that the Analyzer "zero" is checked using the auto zero screen and not the normal reading screen.

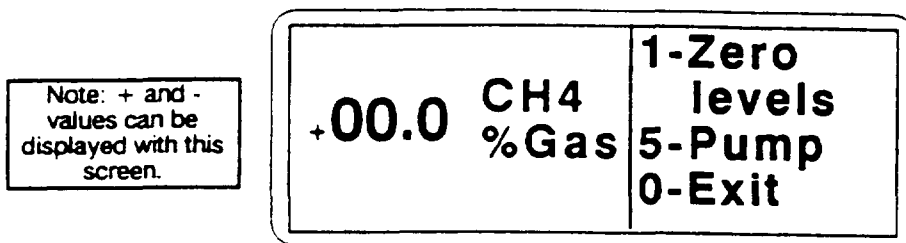
Ensure that the Analyser is cleared of any Methane at the time of zeroing. The Analyzer should not be auto-zeroed near a Landfill site because there may be Methane in the surrounding atmosphere.

When you perform the auto-zeroing operation the Analyzer will re-calculate 16 calibration points and store the revised data in its memory. The Analyser does not need to be auto-zeroed every time it is switched on because it remembers its revised calibration even after it is switched off.

If the internal battery is allowed to discharge totally, indicated by the message "memory lost" at switch-on, any revised zero settings will be lost and the Analyzer will revert to its de-fault zero settings.

### 1.3.9 To auto-zero the Analyzer

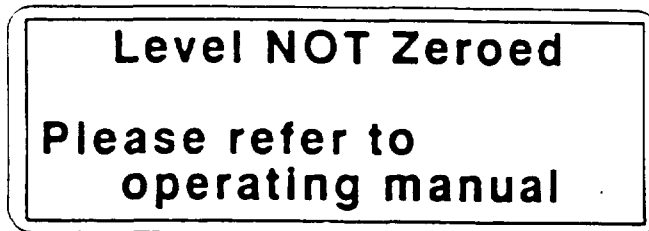
Press key 2 from the Gas Alarm/Zero menu, the following screen will appear -



When you press Key 1 - Zero Levels, the Analyzer will auto-zero. The following message will be displayed before you are returned to the screen above -

CH<sub>4</sub> Zeroed !

### 1.3.10 If the Analyzer cannot auto-zero, the following screen will display -

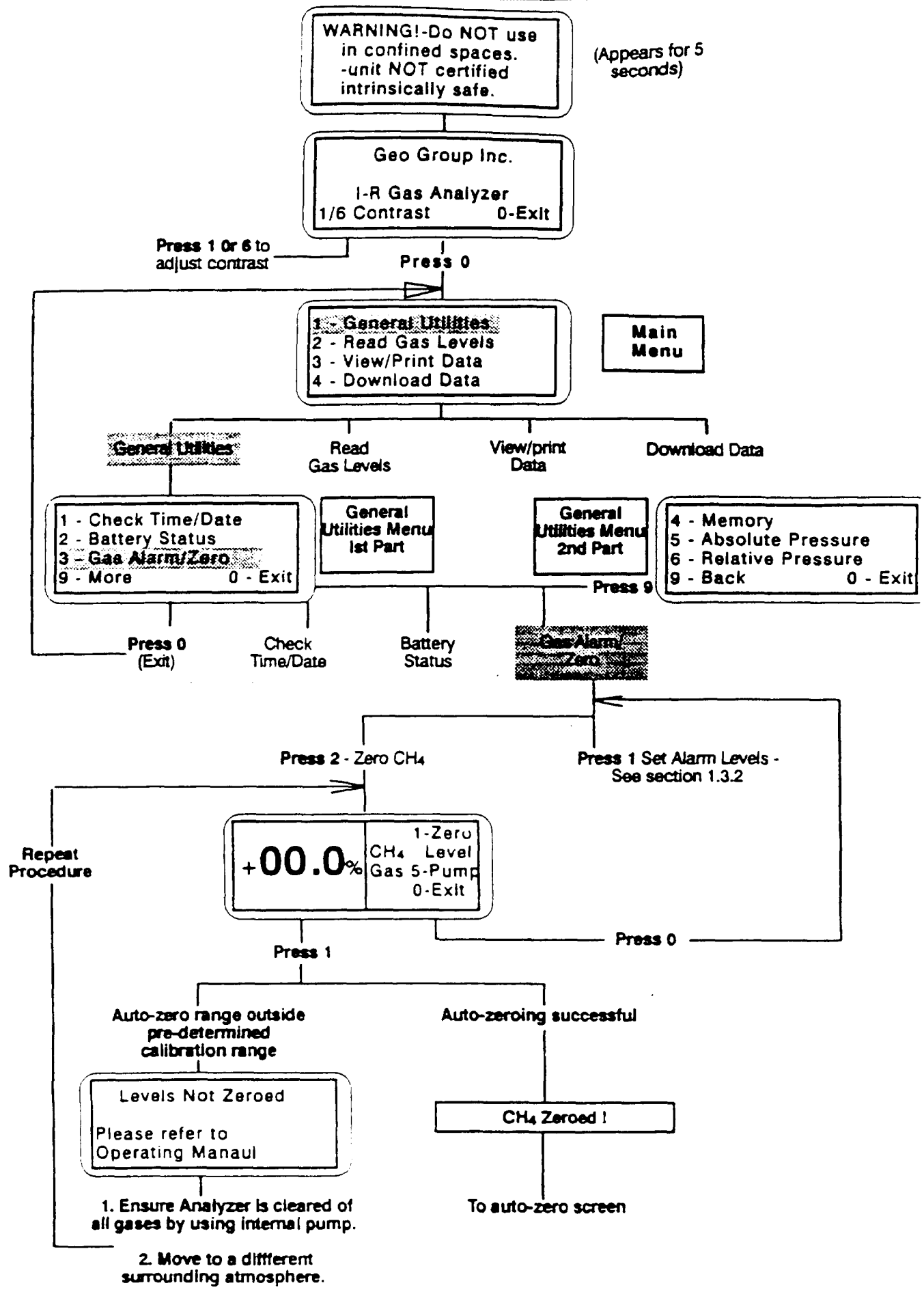


The main reason for this is because the Analyzer is trying to auto-zero to a level which is outside the pre-determined range set when the unit was first calibrated at the factory.

To rectify this, first ensure the Analyzer is cleared of all gas residues which could be affecting the zero level. Use the Analyzers pump to clear internal parts and ensure the surrounding atmosphere is not affecting the level by moving to a different area.

If the Analyzer continues to fail in auto-zeroing then the unit must be returned to Geo Group Inc. for checking.

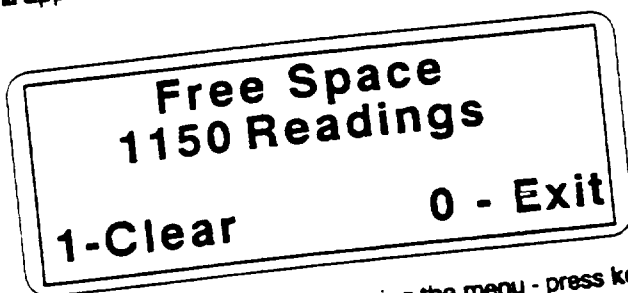
**Summary** **General Utilities - Gas Alarm/Zero**



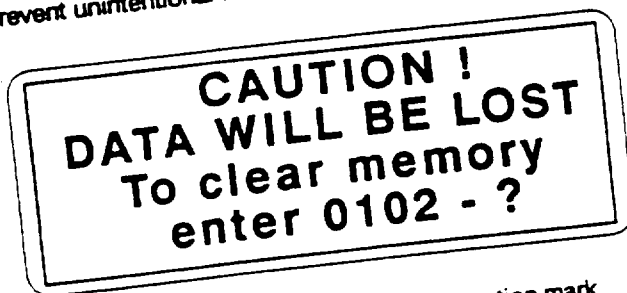
## Check Memory

This section describes how to check the available free space in memory and also to clear the memory, thus allowing new readings to be stored.

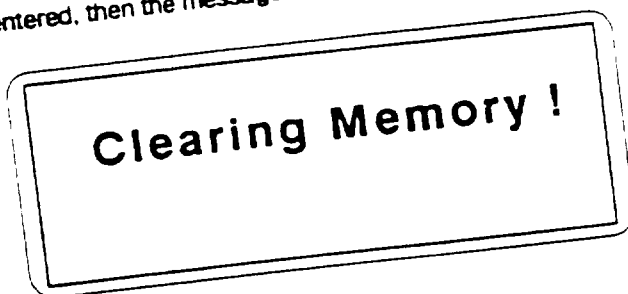
- 2 From the 1st part of the General Utilities Menu, press key 9 - More, then press key 4 - Memory. The following screen will appear.



- 1 To return to the General Utilities Menu - without clearing the menu - press key 0-Exit.
- 1.4.4 If the memory is to be cleared, then press key 1 - Clear Memory. This will result in the following screen being displayed in order to prevent unintentional memory clearance.

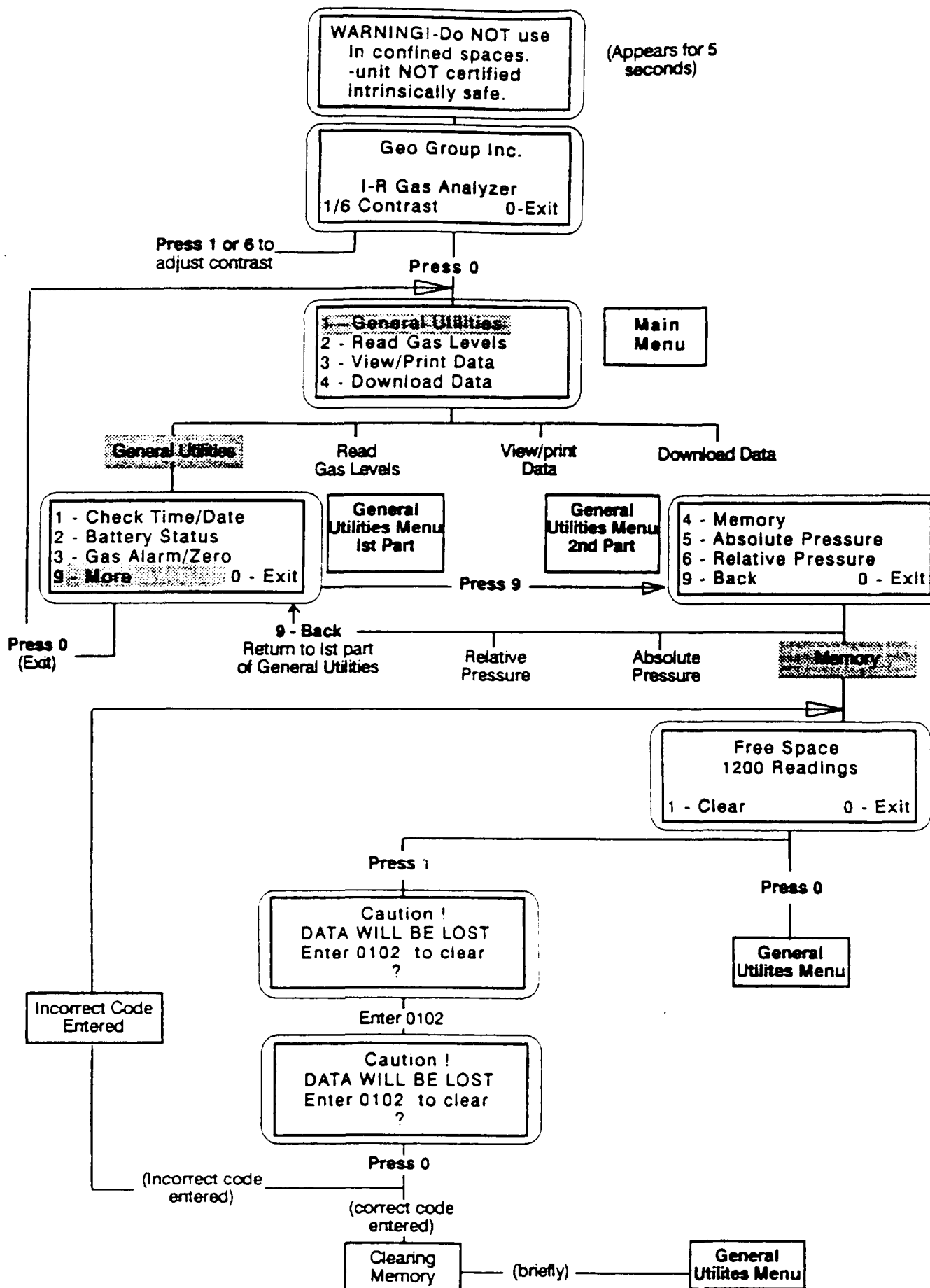


- 1.4.5 The code 0102 should now be entered as prompted by the question mark.
- 1.4.6 If an incorrect code is entered, the unit will reject it and the operator will be returned to the screen in paragraph 1.4.2.
- 1.4.7 If the correct code is entered, then the message



will briefly appear, prior to a return to the General Utilities Menu.

The total capacity of the memory is 1200 readings.



## 1.5 Atmospheric Pressure - Absolute or Relative Reading

The Analyzer has the facility to measure the atmospheric pressure in two separate ways - as an absolute reading or a reading relative to a fixed datum.

The relative reading facility is particularly useful when measuring the pressure in gas extraction systems. The display will show a reading that is + or - in relation to the datum.

### 1.5.1 Absolute Pressure Mode

From the General Utilities 1st screen, press key 9 - More, to reveal the 2nd General Utilities Screen. This screen will be displayed -

**4-Memory  
5-Absolute Pressure  
6-Relative Pressure  
9-Back                      0 - Exit**

By pressing Key 5 - **Absolute Pressure**, the unit will be displaying the atmospheric pressure in absolute terms. The following message will be briefly displayed before returning to the General Utilities Menu -

**Absolute Pressure  
Mode Set**

**Note:** If an atmospheric pressure mode is not selected after turning on, then the unit will automatically default to the absolute setting.

### 1.5.2 Relative Pressure Mode

To select this mode of reading, from the 2nd General Utilities Menu screen, press key 6 - **Relative Pressure** the following display will appear -

**Present Atmospheric  
Pressure is + 410" H<sub>2</sub>O  
Press key 1 to Zero  
0-Exit (No Zero)**

This screen gives you the option of selecting the current pressure reading (displayed on the screen) as the fixed datum for which all future readings will be relative to.

When key 1 is pressed the analyser immediately starts to read the atmospheric pressure relative to the last displayed reading, the following screen will appear briefly before returning to the General Utilities Menu -

**Relative Pressure  
Mode.  
Present atmospheric  
pressure is + 000" H<sub>2</sub>O**

If you decide not to select the current atmospheric pressure as the fixed datum, then press 0 - Exit, and you will be returned to the 2nd General Utilities screen, shown in 1.5.1. The previously chosen reading mode - absolute or relative (with the previous fixed datum) will be retained.

- 1.5.3 To determine which type of atmospheric pressure mode you have selected, the Read gas Level screen will show "R" just after the inches H<sub>2</sub>O reading for a relative reading, which will also be positive or negative.

This screen shows an example -

CH <sub>4</sub>	03.5%	1-LEL%
CO <sub>2</sub>	12.6%	5-Pump OFF
O <sub>2</sub>	20.7%	6-Store
"H <sub>2</sub> O	-010R	8-Log0-Exit



## 2. Read Gas Levels

This section instructs the operator on the methods of obtaining data - both manually and by automatic data logging.

### 2.1 Manual Operation

2.1.1 From the Main Menu, press key 2 - Read Gas Levels. Note: the aspirator pump will be in the OFF position and the readings shown on the display will not represent the gas required until the pump has drawn a sample into the sampling chamber. For the first 30 seconds a row of asterix will be displayed before the first reading appears. If the asterix symbols remain at the CH<sub>4</sub> location after the initial 30 seconds then the Analyzer is outside the acceptable negative zero range and requires auto-zeroing (see section 1.3).

CH <sub>4</sub> 03.5%	1-LEL%
CO <sub>2</sub> 12.6%	5-Pump OFF
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

2.1.2 The left-hand side of the display shows the current gas concentrations being analyzed by the unit together with the current atmospheric pressure. Please note that the data logging option, concentration of Oxygen and the reading of atmospheric pressure will not be displayed unless these options have been fitted to the particular unit which is being used.

The controls and information on the right hand side of the screen will now be examined in detail.

2.1.3 1- LEL%.

CH <sub>4</sub> 03.5%	1-LEL%
CO <sub>2</sub> 12.6%	5-Pump ON
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

If key 1 is pressed the display will change to show the concentration of methane both in terms of percentage by volume and percentage of the Lower Explosive Limit.

03.5	CH <sub>4</sub> %Gas	5-Pump ON
070	CH <sub>4</sub> %LEL	6-Store 0-Exit

The Lower Explosive Limit of Methane is equal to a 5% concentration of Methane by volume in air. (Percentage by volume is termed here as %gas). Thus the following relationships are derived -

For Methane - 1.0% gas = 020.% LEL  
 2.0% gas = 040.% LEL  
 3.0% gas = 060.% LEL  
 4.0% gas = 080.% LEL  
 5.0% gas = 100.% LEL

Therefore in the example given, the display shows 3.5% gas = 70% LEL. If key 0-Exit is pressed, the display will revert to that shown at the beginning of this paragraph.

#### 2.1.4 5 - Pump.

CH <sub>4</sub> 03.5%	1-%LEL
CO <sub>2</sub> 12.6%	5-Pump <b>ON</b>
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

When the sampling probe is located at the required location, pressing key 5 - Pump will draw a gas sample into the the readout unit. After approximately 20 - 30 seconds the readings will stabilise to represent the gas concentrations drawn in by the aspirator pump.

To stop the pump, press key 5 - Pump again.

Control of the pump in this manner may be effected whilst either of the foregoing types of screen are being displayed.

#### 2.1.5 6 - Store.

Irrespective of which screen is being shown,

CH <sub>4</sub> 03.5%	1-%LEL
CO <sub>2</sub> 12.6%	5-Pump <b>ON</b>
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

or

03.5 CH <sub>4</sub>	5-Pump
%Gas	<b>ON</b>
070 CH <sub>4</sub>	6-Store
%LEL	0-Exit

If key 6 - Store is pressed, readings of all gases will be stored in the memory as follows.

As soon as key 6 is pressed, the screen will change to -

Please Enter IDC
- Numbers/Letters
IDC ?

The operator is now being prompted by the screen to enter an 8 character alphanumeric code (in 2 sets of 4) which will identify the set of readings. This could be, for example, the site name and borehole number etc.

The unit will automatically start with a ?, where you can enter a number 0 - 9. When a number is entered the ? automatically moves on to the next space to the right.

To change from numbers to letters for the code, simply press the **Backlight** key, and the highlighted area of the screen will change to indicate you have selected letters for entering. The letter A will appear on the screen in the next available code space.

You can change to any letter of the alphabet and a range of symbols by pressing the up and down arrows. When the letter you require appears on the screen, press the **0** key to enter it into the unit's memory. Following this choice the next space to the right will automatically display the letter you chose before, so again use the up and down keys to select the required letter or symbol and press the **0** key to enter. If you change back to numbers the ? will appear on the screen again.

**Please Enter IDC**  
 ? - Numbers/**Letters**  
 IDC 123A  
 ↑ ↓ - Step      0 - Enter

The rubout key (key 0, keep it pressed) may be used to correct any errors. A space is automatically inserted between the first four characters and the second four. When an eight character code has been correctly entered, the message **0 - Store** will appear in the lower right hand corner of the screen thus -

**Please Enter IDC**  
 ? - Numbers/**Letters**  
 IDC ABCD 1234  
 0 - Store

As soon as key **0 - Store** is pressed the screen will change to

**Readings Stored!**

for a few moments, prior to returning to the relevant display of gas concentrations.

CH <sub>4</sub> 03.5%	1-%LEL
CO <sub>2</sub> 12.6%	5-Pump <b>ON</b>
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

03.5	CH <sub>4</sub> %Gas	5-Pump	ON
070	CH <sub>4</sub> %LEL	6-Store	0-Exit

#### 2.1.6 Default Selection of last IDC Code Entered.

When you take a second reading and chose to store the data with an identity code, the unit will automatically display the first four characters of the last Identity Code entered. This assists you in keeping a sequence of readings related and speeds up the entry of codes.

If the first four characters of the last code entered are not required, then you can delete these using the Rubout Key (Key 0, keep it pressed to delete). Once deleted the first four characters can be replaced with the required code.

This entering procedure and default facility will operate for all the options requiring an identity code to be entered, View/Print Data and Download Data.

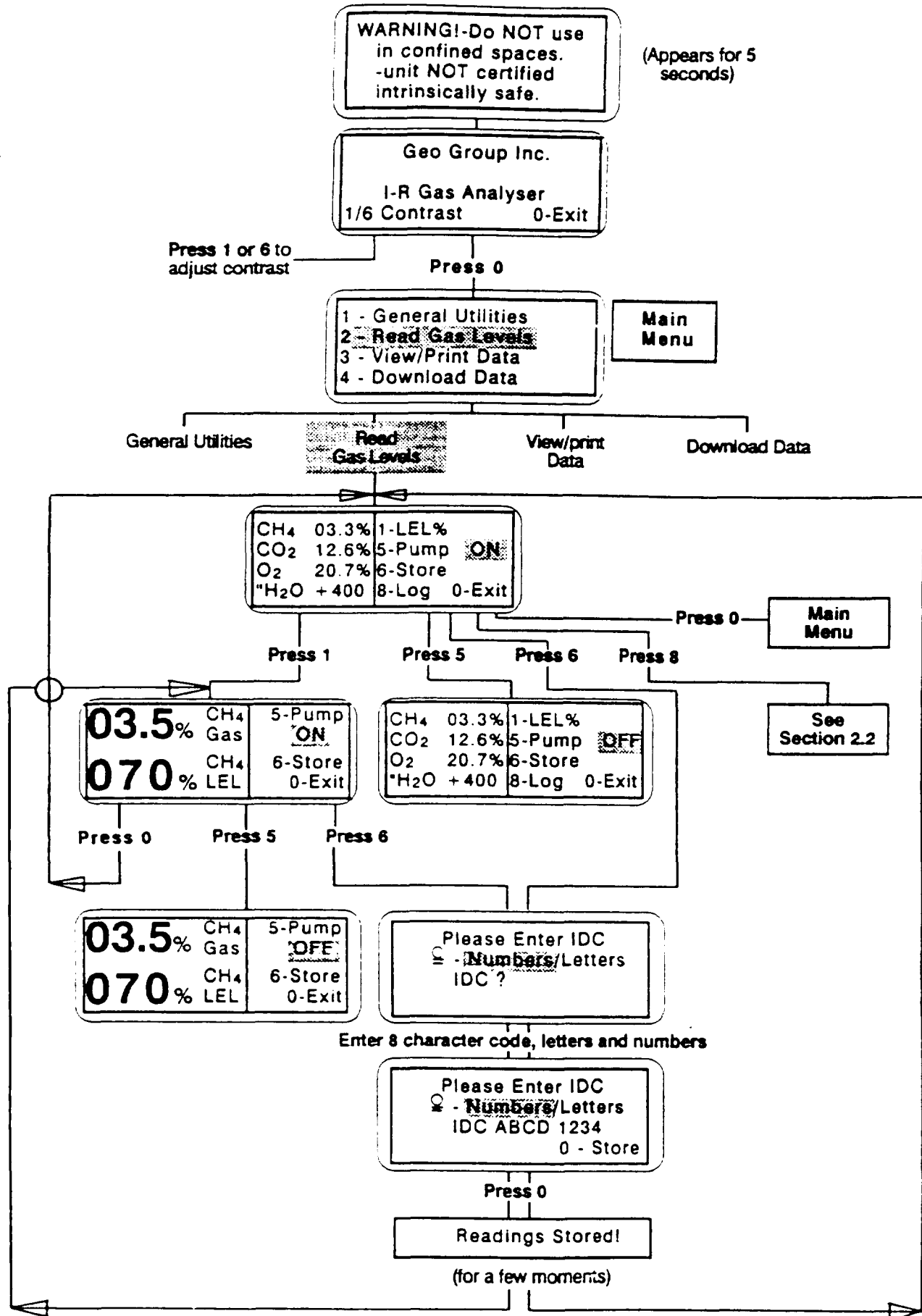
#### 2.1.7 8 - Log.

This will be described in detail under Section 2.2 - Automatic Operation (Data Logging).

#### 2.1.8 0 - Exit.

CH <sub>4</sub> 03.5%	1-%LEL
CO <sub>2</sub> 12.6%	5-Pump ON
O <sub>2</sub> 20.7%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

If key 0 - Exit is pressed, the operator will be returned to the Main Menu. If the aspirator pump is running it will automatically shut down.



## 2.2 Automatic Operation (Data Logging) (If option fitted)

2.2.1 This section of the manual explains how to obtain readings using an unattended unit.

Prior to commencing any logging operation it is imperative that alarm levels have been correctly set (see section 1.3) and that battery life is sufficient to allow the Gas Analyser to obtain readings for the whole duration of the logging operation. In this respect, the use of a battery pack should be considered.

2.2.2 From the Main Menu, press key 2 - Read Gas Levels. The pump will start and the display will change to -

CH <sub>4</sub> 01.4%	1-%LEL
CO <sub>2</sub> 00.3%	5-Pump ON
O <sub>2</sub> 20.5%	6-Store
"H <sub>2</sub> O + 400	8-Log 0-Exit

2.2.3 Now press key 8 - Log. The screen will change to -

Please Enter IDC  
- Numbers/Letters  
IDC ?  
↑ ↓

The operator should now enter an eight character code which will be used to identify the complete set of logged readings. Follow the prompting on the screen and use the rubout (key 0, keep it pressed) to correct any errors. See Pages 28-29 for a full explanation of the code entering facilities.

(The unit will display the first four characters of the last IDC entered, which can be deleted if necessary). When the eight character code has been entered, 0 - Store will appear in the lower right hand corner of the screen.

Please Enter IDC  
- Numbers/Letters  
IDC ABCD 1234  
0 - Store

2.2.4 Press Key 0 - Store to store the Identity code (IDC) and the following screen will be displayed

Enter Required  
Logging Interval  
Min 5, Max 60 Minutes  
Interval = ?

The operator is now being prompted to enter the time between each reading (Interval). As indicated on the screen, the minimum logging interval is 5 minutes and the maximum is 60 minutes.

2.2.5 When two digits have been entered, the screen will change to -

**Enter Required  
Logging Interval  
Min 5, Max 60 Minutes  
Interval = 15 0 - Exit**

The operator should press key 0 to confirm the required interval time and then the following display will appear. If the operator attempts to enter an invalid logging interval, he will be returned to the screen at the beginning of paragraph 2.2.4.

2.2.6

**Select Running Time  
for Pump  
15, 30, 45, 60, 90 secs.  
Time = ?**

The operator is now being prompted to select and enter the time that the pump will run prior to any reading being logged. Determination of this period should be based on the local conditions - length of tube, gas concentrations etc. The length of pump running time which can be entered is limited to the alternatives shown on the screen.

2.2.7 When two digits have been entered, the screen will change to -

**Select Running Time  
for Pump  
15, 30, 45, 60, 90 secs.  
Time = 30 0-Exit**

The operator should now press key 0 to confirm the pump running time. If the entered pump running time is not one of the available choices, the display will revert to that shown at the beginning of paragraph 2.2.6 in order that another attempt may be made to enter a valid time.

2.2.8 When key 0 - Exit has been pressed, the display will confirm that a logging sequence has been initiated thus -

CH <sub>4</sub> 01.4%	<b>Logging</b>
CO <sub>2</sub> 00.3%	
O <sub>2</sub> 20.5%	1-LEL%
"H <sub>2</sub> O + 400	0-Stop Log

- 2.2.9 During a logging sequence, the 15 minute "auto power off" facility is inhibited and current data will be displayed for as long as logging is allowed to continue.

Starting and stopping of the aspirator pump will be automatic and under the control of the Gas Analyser.

- 2.2.10 The operator may view concentrations of Methane expressed as a percentage LEL without disturbing the logging sequence by pressing Key 1 whilst the previous screen is displayed, thus -

01.4	CH <sub>4</sub> %Gas	<b>Logging</b>
028	CH <sub>4</sub> %LEL	0 - Exit

- 2.1.11 To stop a logging sequence, the following procedure should be adopted.

Whilst the above screen is being displayed, press key 0 - Exit. The screen described in paragraph 2.2.8 will return.

CH <sub>4</sub> 01.4%	<b>Logging</b>
CO <sub>2</sub> 00.3%	
O <sub>2</sub> 20.5%	1-LEL%
"H <sub>2</sub> O + 400	0-Stop Log

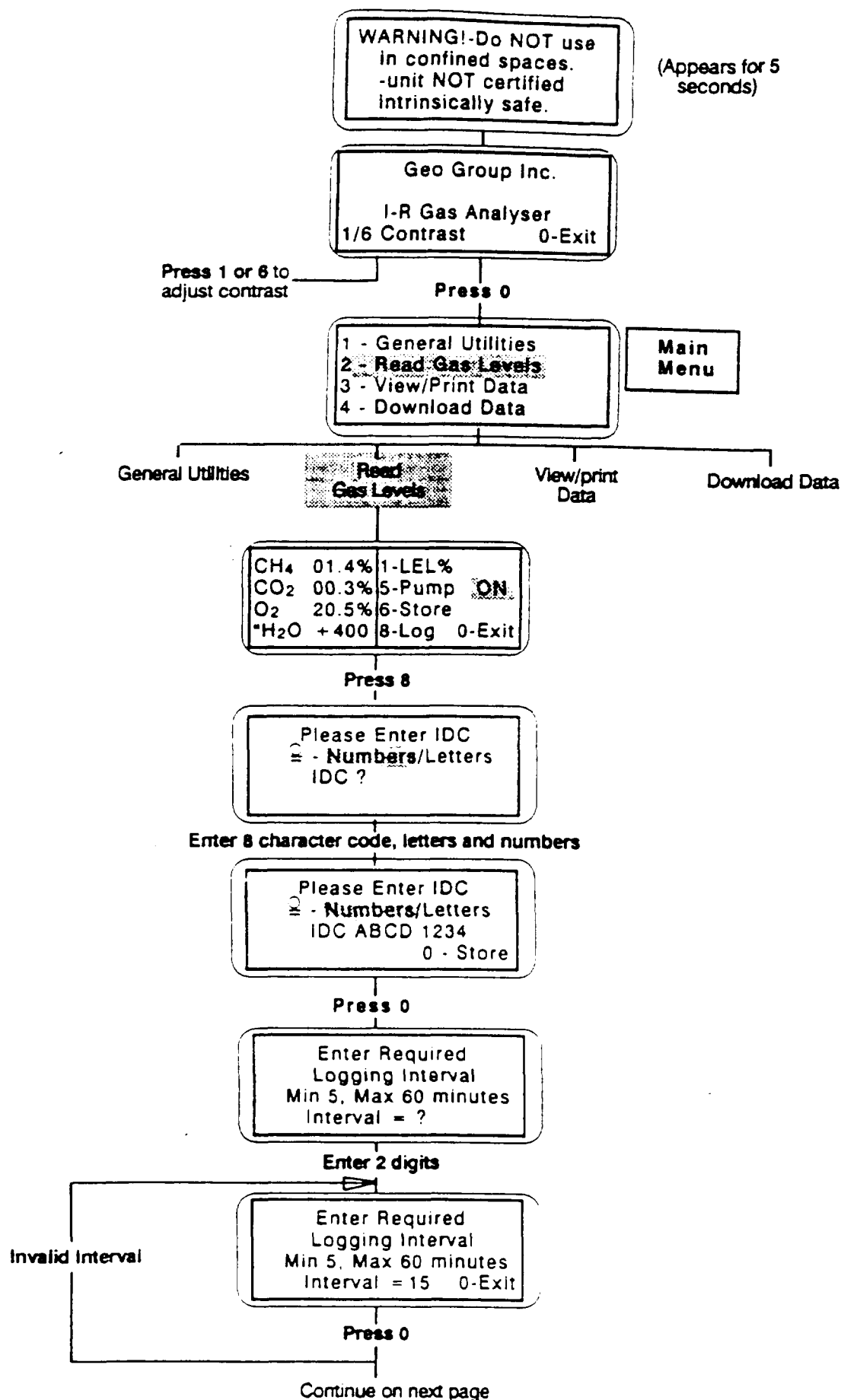
- 2.2.12 Key 0 - Stop Log should now be pressed and confirmation will be provided by the brief message -

<b>Logging Stopped!</b>
-------------------------

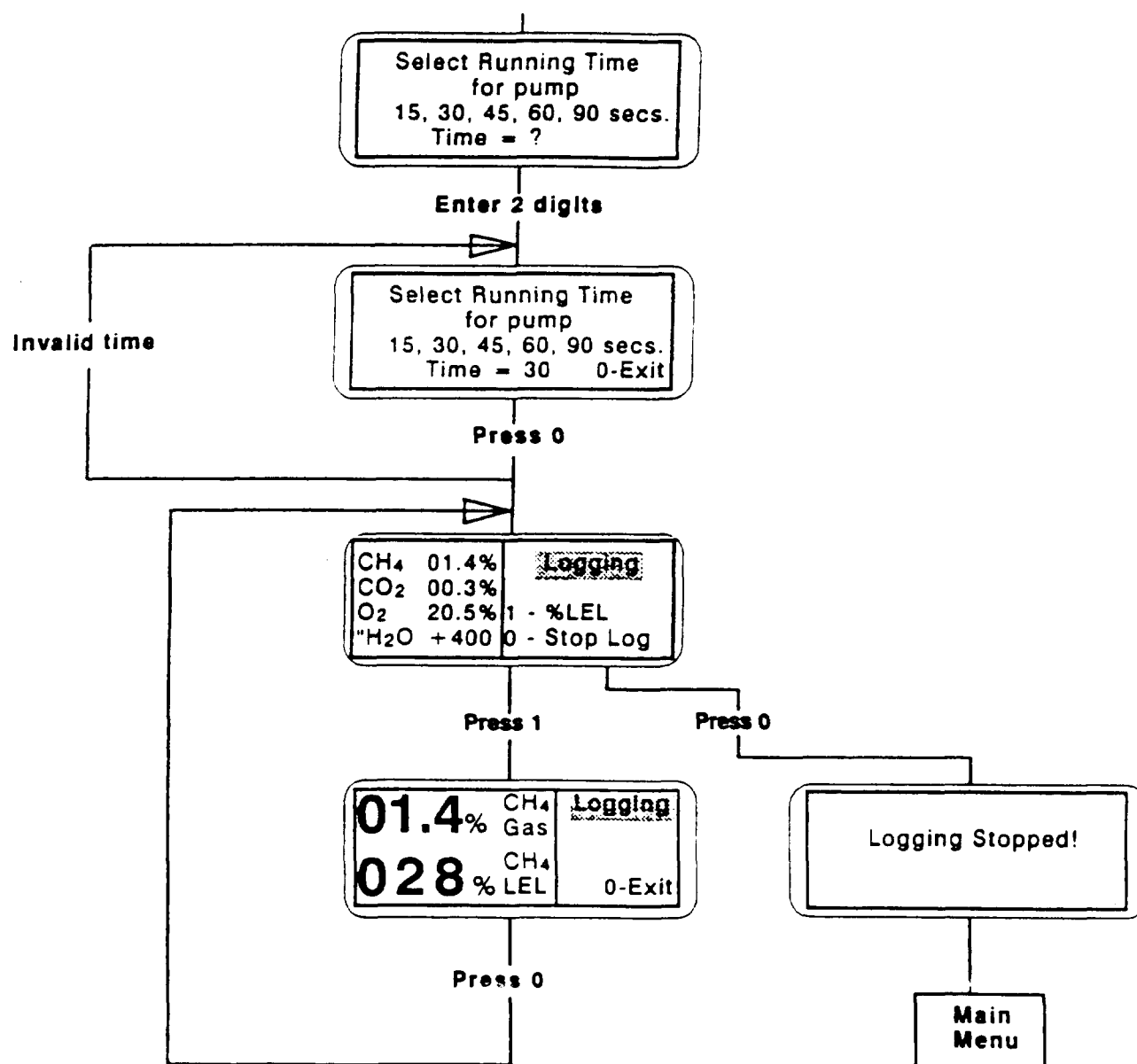
prior to the operator being returned to the **Main Menu**. All data gathered during **data logging** will have been **automatically stored** in the memory of the Gas Analyser.

If the readout battery is allowed to totally discharge during logging, then the last few readings should be discarded.





Continued from previous page



### 3. View/Print Data

This section of the manual describes how to scan or obtain a hard copy of data which has previously been stored in the memory of the Gas Analyzer.

From the Main Menu, press key 3 - View/Print Data.

The View/Print Menu will appear

**Please Select**  
**1-View Data**  
**2-Print Data**  
**0-Main Menu**

unless no data has been stored, in which case the message

**NO DATA**  
**AVAILABLE**

will briefly appear, prior to an immediate return to the Main Menu.

#### 3.1 View Data

##### 3.1.1 From the View/Print Menu,

**Please Select**  
**1-View Data**  
**2-Print Data**  
**0-Main Menu**

Select key 1 - View Data. The following screen will appear.

##### 3.1.2

**View Data**  
**1-With Specific IDC**  
**5-All data**

This screen enables the operator to select for viewing only data which has been stored with a specific IDC (Identity Code). All other data will be ignored.

This facility can be used to avoid scanning through irrelevant data if, for example, data from only one borehole or one site is to be examined.

If **key 1 (Specific IDC)** is pressed then only data for the particular IDC chosen will be presented.

If **key 5 (All data)** is pressed, then the entire memory of the Gas Analyzer will be presented in chronological order.

**3.1.3** Assuming that only data with a specific Identity Code is required, now press **key 1 - With Specific IDC**.

**Please Enter IDC**  
**○ - Numbers/Letters**  
**IDC ?**

This screen now asks the operator to enter the chosen IDC. The code should be entered as prompted by the question mark. Use the **Rubout Key (Key 0, keep it pressed)** to correct any errors. The unit will display the first four characters of the last IDC entered, which can be deleted if necessary. See Pages 28-29 for a full explanation of code entering facilities. When eight characters have been entered, the message **"0 - Exit"** will appear in the lower left hand corner of the screen, thus -

**Please Enter IDC**  
**○ - Numbers/Letters**  
**IDC ABCD 1234**  
**0 - Store**

**Key 0 - Store** should now be pressed. If data with the entered IDC is not present in the memory of the unit, then the message

**Cannot find**  
**IDC ABCD 1234**  
**1 - Another IDC 0-Exit**

will appear.

**3.1.4** If **key 1 - Another IDC** is now pressed, the operator will be returned to the screen in paragraph 3.1.3 for another attempt at entering a valid IDC. If **key 0 - Exit** is now pressed, the operator will be returned to the View/Print Menu.

**Please Enter IDC**  
**○ - Numbers/Letters**  
**IDC ABCD 1234**  
**0 - Store**

3.1.5 When key 0 - Exit is pressed from the screen

Use these keys  
2-Go to first      0-Exit  
7-Go to last      ↑↓-Scan  
Any key to Continue

and data with the chosen IDC is present in the memory, then a screen describing how to search through will be presented to the operator, thus

CH <sub>4</sub> 03.5%	Corrected
CO <sub>2</sub> 12.6%	ID ABCD1234
O <sub>2</sub> 20.7%	Taken 12:45
"H <sub>2</sub> O + 400	06/24/90

The various facilities described in this screen will not be functional until data is being scanned. Thus press any key to continue and a screen similar to the following one will appear

3.1.6 The above screen is chronologically the first data which is available. (If a specific IDC was entered, it will be chronologically the first data available which has that IDC).

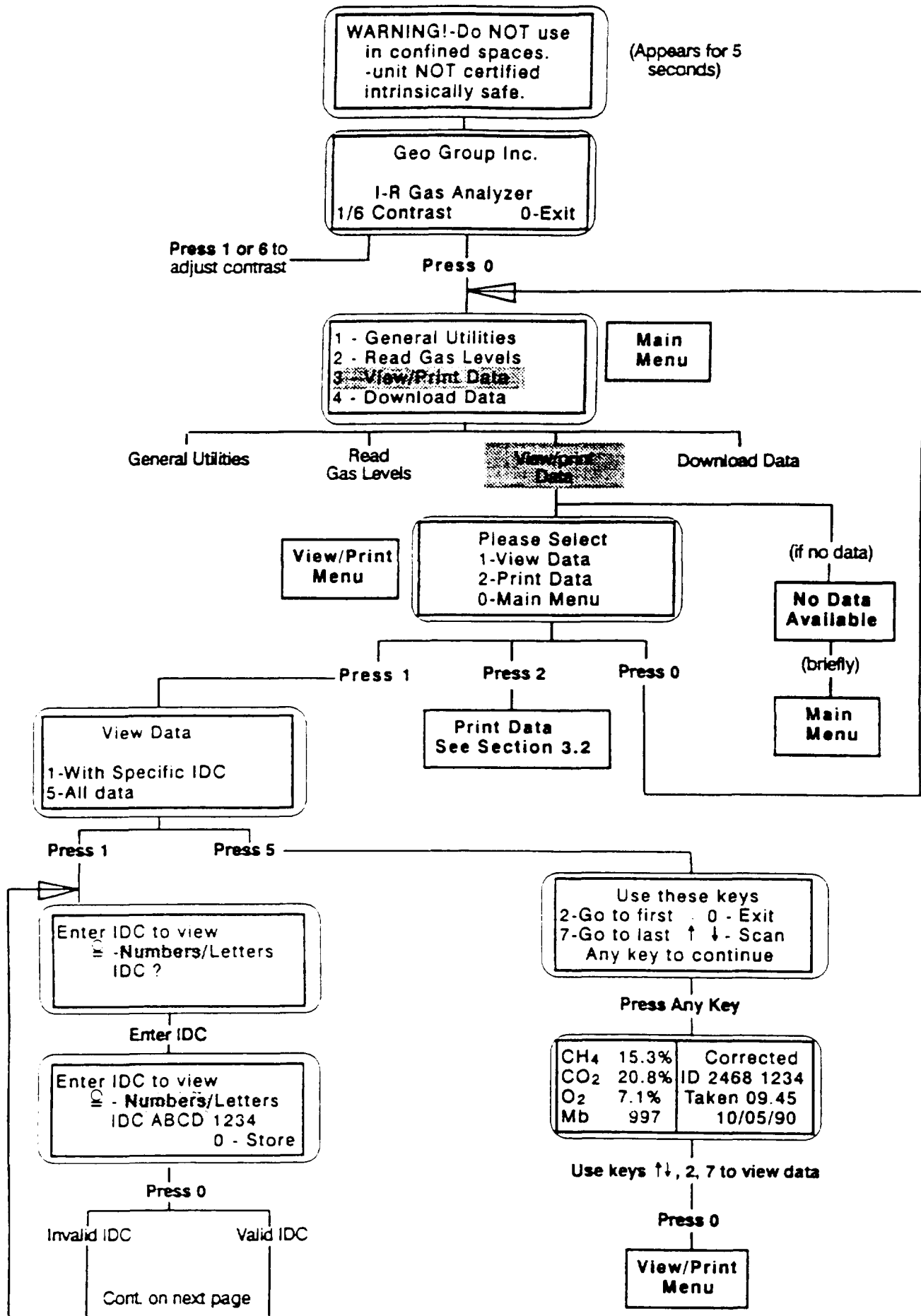
The various concentrations (in terms of percentage gas) of sampled gases are being displayed, together with the Identity Code, and time and date of reading. The data can be searched as follows

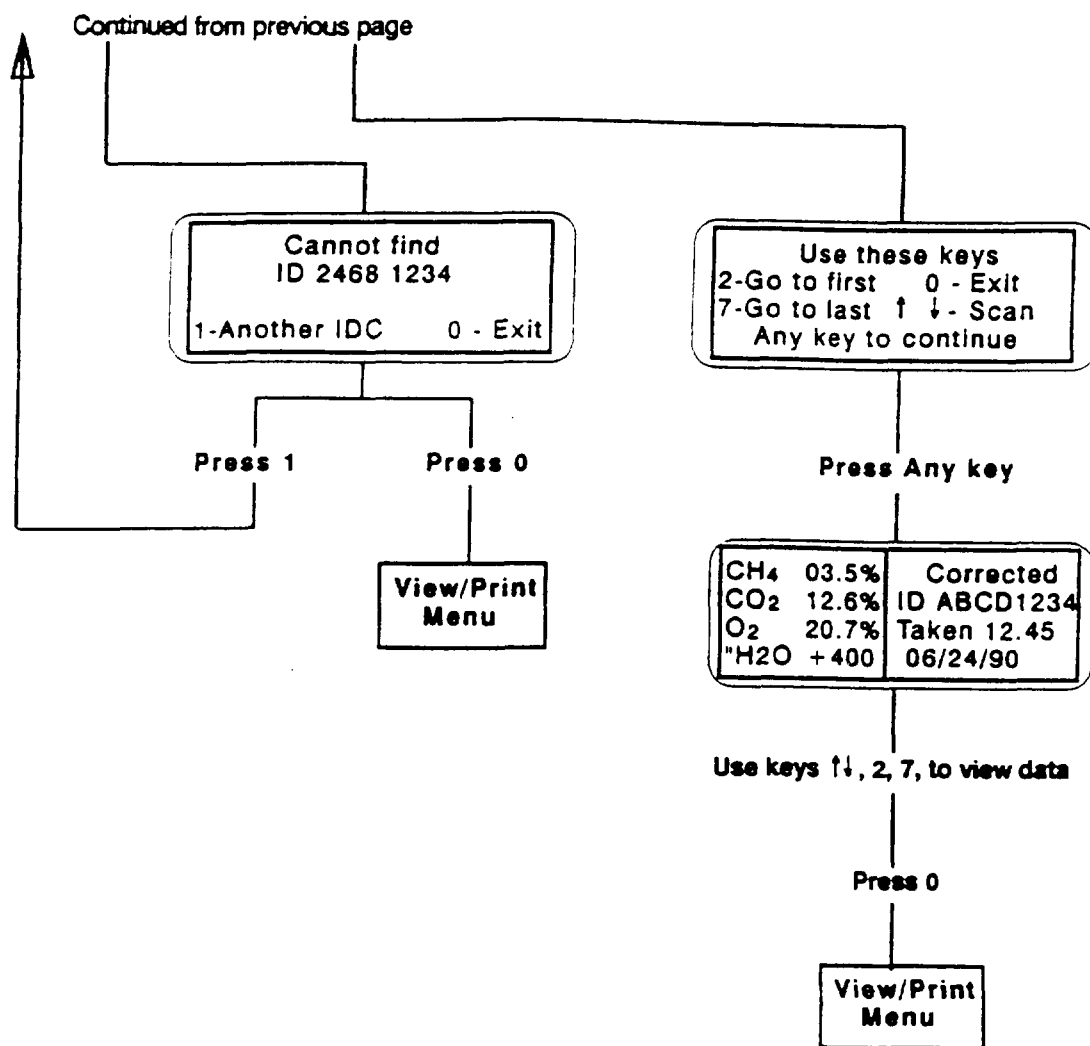
- Press ↓ (key 6) to view the next reading in chronological order.
- Press ↑ (key 1) to view the previous reading in chronological order.
- Press key 2 to view the first reading in chronological order.
- Press key 7 to view the last reading in chronological order.

Please Select  
1-View Data  
2-Print Data  
0-Main Menu

Please note that unless the particular Gas Analyzer which is being used has been fitted with relevant options, then Oxygen percentage and atmospheric pressure may not be displayed.

3.1.7 When all required data has been viewed, press key 0 - Exit to return to the View/Print Menu.





### 3.2 Print Data

#### 3.2.1 From the View/Print Menu

Please Select  
1-View Data  
2-Print Data  
0-Main Menu

Select key 2 - Print Data. The following screen will appear.

#### 3.2.2

Print Data  
1-With Specific IDC  
5-All data

The screen allows the operator to select for printing only data which has been stored with a specific IDC (Identity Code). All data stored with other Identity Codes will be ignored.

Thus, if key 1 (Specific IDC) is pressed then only data with the particular IDC chosen will be printed. If key 5 (All data) is pressed, then the entire memory of the Gas Analyser will be printed in chronological order.

#### 3.2.3 Assuming that only data with a specific identity code is required now press key 1 - With Specific IDC.

Please Enter IDC  
○ - Numbers/Letters  
IDC ?

This screen now asks the operator to enter the chosen IDC. The code should be entered as prompted by the question mark. Use the Rubout Key (Key 0, keep it pressed) to correct any errors. The unit will display the first four characters of the last IDC entered, which can be deleted if necessary. For a full explanation of the code entering facilities see pages 28-29.

#### 3.2.4 When eight characters have been entered, the message "0 - Store" will appear in the lower right hand corner of the screen, thus -

Please Enter IDC  
○ - Numbers/Letters  
IDC ABCD 1234  
0 - Store



Key 0 - Store should now be pressed. If data with the entered IDC is not present in the memory of the unit, then the message

**Cannot find  
IDC ABCD 1234  
1 - Another IDC 0-Exit**

will appear.

**3.2.5** If key 1 - Another IDC is now pressed, the operator will be returned to the screen in paragraph 3.2.3 for another attempt at entering a valid IDC.

If key 0 - Exit is pressed, the operator will be returned to the View/Print Menu.

**3.2.6** When key 0 - Store is pressed from the screen

**Please Enter IDC  
- Numbers/Letters  
IDC ABCD 1234  
0 - Store**

and data with the chosen IDC is present in the memory, then an attempt will be made to print data.

**3.2.7** For printing to occur successfully the following conditions must be satisfied.

- A printer with a serial interface e.g. Diconix model 150 must be connected correctly to the communications port of the Gas Analyser.
- Printer Settings - Your printer must be set to these ratings -

Baud Rate	2400
Handshake	RTS/CTS
Parity	None
Data bits	8
Stop bits	1

If you are not sure how to alter your printer settings, please consult your printer manual.

- RS232C Communications Lead - the lead used to connect the Gas Analyzer to the printer must be the type supplied by Geo Group Inc.
- A sufficient supply of continuous fan fold paper must be available and correctly fitted in the printer.

**3.2.8** If an attempt at printing is made and the above conditions are not satisfied, then the following message will appear.

**PRINTER ERROR**  
**CHECK-Connections**  
**Paper Supply etc?**  
**6-Retry                      0 - Exit**

If the attempt at printing is to be aborted, press key 0 - Exit and the View/Print Menu will appear.

- 3.2.9 If another attempt at printing is to be made, check again that the conditions for printing are fulfilled and then press key 6.

If the conditions are not satisfied the screen in paragraph 3.2.8 will reappear.

If, however, the printing conditions are satisfied, then the message

**Printing - Please Wait**

will be displayed. This message will remain on screen whilst printing is taking place.

- 3.2.10 The print format is

Time	Date	IDC	%CH <sub>4</sub>	%CO <sub>2</sub>	%O <sub>2</sub>	"H <sub>2</sub> O
12:45	06/2490	ABCD 1234	03.5	12.6	20.7	+ 400

If a specific IDC has been selected, the printout will give data in chronological order for that IDC.

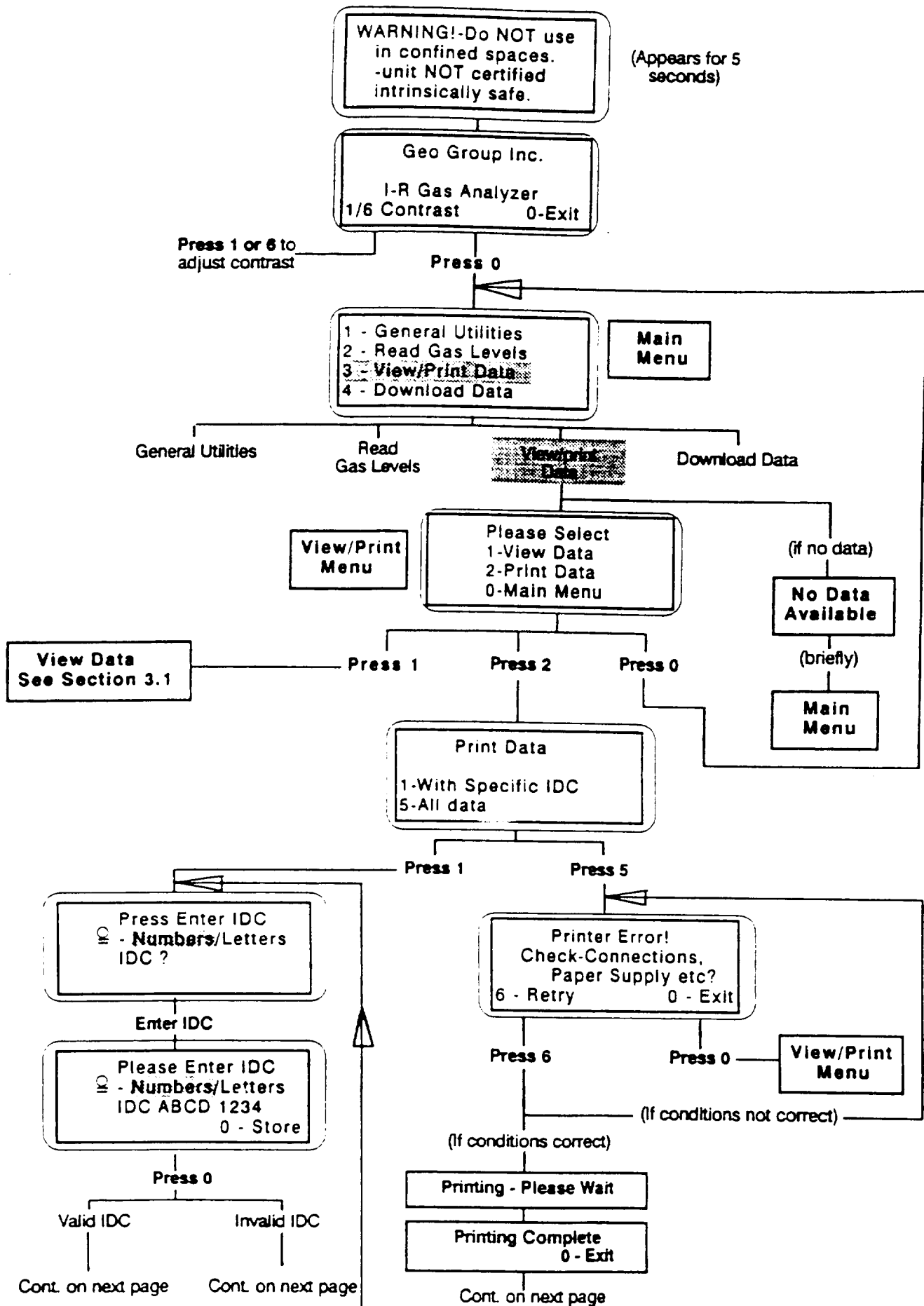
If no IDC has been selected, the printout will be in strict chronological order.

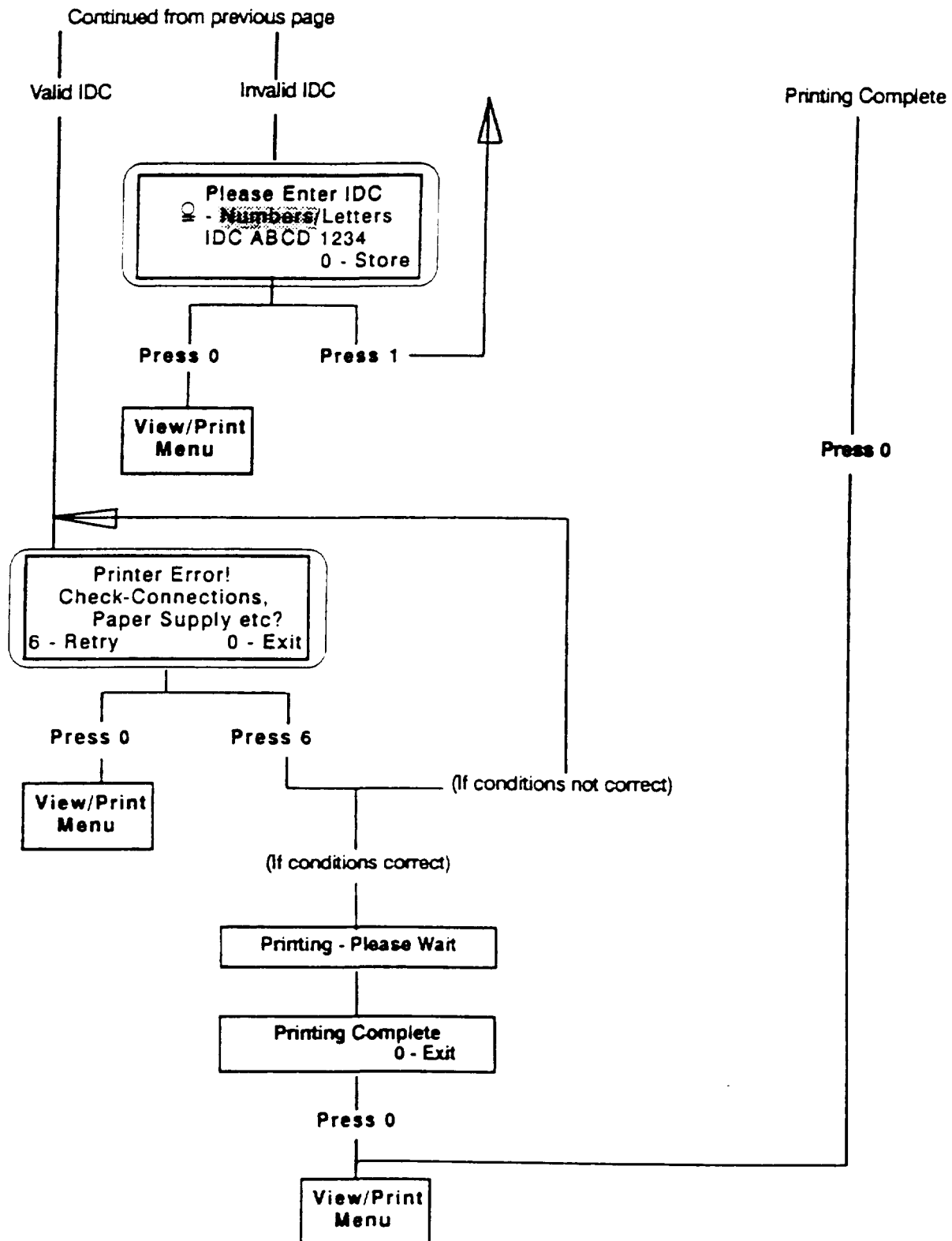
- 3.2.1 When all relevant data has been printed the message

**Printing Complete**  
**0 - Exit**

will appear.

If key 0 - Exit is pressed, the View/Print menu will re-appear.





## 4. Download Data

This section of the manual describes how to download data stored in the memory of the Gas Analyzer to a suitable IBM PC or compatible computer that is running Geo Group Inc. Universal Download Software (UNI\_DOWN).

This software accepts the data from the Gas Analyzer in binary format and converts it into ASCII format (referred to as CSV in the UNI\_DOWN program) which is then suitable for importing into most popular spreadsheet programs e.g. LOTUS 1-2-3 or SuperCalc. For more information, consult your spreadsheet program manual on importing different file formats.

Note: for users of spreadsheet programs the correct file importing option is defined on the screen as "Numbers".

### 4.1 Download Data Operation

To achieve successful downloading of data it is advisable to be familiar with the operation of the UNI\_DOWN software program you are running on the computer. Please refer to the relevant section of the operating manual supplied with the software in conjunction with this manual. In addition, the computer provides on-screen help when you proceed with the operation.

The download function allows you to download all data in the Gas Analyzer memory or selected data only. Selected data is chosen by specifying either the 8 digit identity code or the time/date of the reading.

- 4.1.1 Turn on the computer and load the UNI\_DOWN software program. The following screen will appear on your computer -

Universal Download Program (version 4.7 20/11/91 IBM PC/XT/PS2)	
<p>Details: This option allows data to be transferred from GA 90 Hand Held Gas Readouts. Data is stored in a form suitable for import into most popular spreadsheets. See manual for details on the "Numbers" format.</p>	<p>Select    1...DTM/VWR</p> <p>            2...INTERROGATOR</p> <p>            3...INCLINOMETER</p> <p>            4...GAS READOUT</p>
Geo Group Inc.	
Use cursor keys to select. Press RETURN to complete. Press ESC to abort.	

- 4.1.2 Turn on the Gas Analyzer and connect to the computer with a RS-232 lead. This lead can be supplied by Geo Group Inc. manufactured to your particular computer connection port specification.

From the main menu press key 4 - Download Data, the following screen will appear on the Gas Analyzer for the duration of the download operation (see over page) -

**RS-232 MODE**

**Awaiting Instruction  
from computer**

- 4.1.2 From the computer select option 4 **GAS READOUT** and press the Return key of your computer. The computer will then download data to its memory, during this process a countdown of readings will be displayed briefly on the right hand side of the computer screen -

**Readings Downloaded**

00150

When all data is in the memory of the computer, but not yet stored to disc, the following screen will appear -

Universal Download Program (version 4.7 20/11/91 IBM PC/XT/PS2)							
<p><b>Please prepare to Download from the Hand Held Gas Readout :-</b></p> <ol style="list-style-type: none"> <li>1) Switch on the unit.</li> <li>2) Connect RS-232 link.</li> <li>3) Press Key "0"</li> <li>4) Enter RS-232 Mode by pressing key "4".</li> <li>5) Wait for data to be received.</li> </ol> <div style="border: 1px solid black; padding: 2px; margin: 10px auto; width: 100px; text-align: center;">Waiting</div>	<p><b>Press RETURN to download all data from the Unit. Press '?' to examine data. It is also possible to store only data based on the following -: borehole, time and date. Using the ← → keys position the cursor then enter the correct digit. Only files where the data entered corresponds to the data in a file will be downloaded. Where 'X' equals any digit.</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Code</th> <th style="text-align: left;">Time</th> <th style="text-align: left;">Date</th> </tr> </thead> <tbody> <tr> <td>XXXX XXXX</td> <td>XX:XX</td> <td>XX/XX/XX</td> </tr> </tbody> </table>	Code	Time	Date	XXXX XXXX	XX:XX	XX/XX/XX
Code	Time	Date					
XXXX XXXX	XX:XX	XX/XX/XX					
Geo Group Inc.							
Use cursor keys to scan data. Press ESC to return to file selection.							

- 4.1.3 The UNI\_DOWN program now provides you with the option to store to disc **all data** or **selected data**. In addition, by pressing the "?" key of your computer you can view all the data downloaded from the Gas Analyzer.

To **Store all data**, simply press the Return key on the computer.

To **Store selected data** based on the identity code or time/date, use the computer keys ← → to position the highlighted cursor over the X characters and enter the desired code or time/date. If you do not need to enter an identity code but only the **time** or **date**, then leave the X characters in place (and vice versa if you do not require an entry for the time or date).

When you have decided which data is to be stored to disc, **selected data** or **all data**, press the **Return** key on your computer and the storing to disc process will commence.

- 4.1.4 When the storing process has finished the following screen will appear on your computer. This screen requests you to input a filename to identify the readings.

Universal Download Program (version 4.7 20/11/91 IBM PC/XT/PS2)								
<b>Please prepare to Download from the Hand Held Gas Readout :-</b>  1) Switch on the unit. 2) Connect RS-232 link. 3) Press Key "0" 4) Enter RS-232 Mode by pressing key "4". 5) Wait for data to be received.		<b>Press RETURN to download all data from the Unit. Press "?" to examine data. It is also possible to store only data based on the following :- borehole, time and date. Using the ← → keys position the cursor then enter the correct digit. Only files where the data entered corresponds to</b>  <div style="border: 1px solid black; padding: 2px;"> <b>Filename:</b> .....         </div> <table> <thead> <tr> <th>Code</th> <th>Time</th> <th>Date</th> </tr> </thead> <tbody> <tr> <td>XXXX XXXX</td> <td>XX:XX</td> <td>XX/XX/XX</td> </tr> </tbody> </table>	Code	Time	Date	XXXX XXXX	XX:XX	XX/XX/XX
Code	Time	Date						
XXXX XXXX	XX:XX	XX/XX/XX						
Geo Group Inc.								
Press RETURN to complete. Press ESC to abort.								

- 4.1.5 The filename can be up to 8 characters long, plus 3 for an extension of your choice. In addition, you can type in a directory path before the filename to locate the data file wherever you like in the memory of your computer.

**Note:** It is advisable to use the conventional extension ".PRN" if you want to import the data files into most popular spreadsheets.

For example -

**C:\GASREAD\SECT12\FILEABC1.PRN**

The filename and directory path chosen must not exceed 30 characters.

When you have completed the filename and directory path, pressing the **Return** key of your computer stores the data on your computer. The computer screen will return to the screen shown in paragraph 4.1.2 ready to download more selected data if required.

If you have completed downloading all the necessary data and wish to disconnect the Gas Analyzer from the computer, press the computer **ESC** key and the program will return to the first screen shown in paragraph 4.1.1.

The Gas Analyzer can now be disconnected and the screen will return to the main menu.

## Computer Operation

Turn on your computer and load  
UNI\_DOWN software

Universal Download Program (version 4.2 14/11/90 IBM PC/XT/PS2)	
<p>Details: This option allows data to be transferred from GA 90 Hand Held Gas Readouts. Data is stored in a form suitable for import into most popular spreadsheets. See manual for details on the 'Numbers' format.</p>	<p>Select: 1. DTMVWR 2. INTERROGATOR 3. INCLINOMETER 4. GAS READOUT</p>
Geo Group Inc.	
Use cursor keys to select. Press RETURN to complete. Press ESC to abort.	

Select option 4 - Gas Readout

Turn on the Gas Analyzer and  
connect to the computer using a  
suitable RS-232 lead.

When key, 4 - Download Data, is  
pressed control of Gas Analyzer is  
taken over by computer and data is  
downloaded - the readings total will  
accumulate on the right hand side of  
the computer screen.

Universal Download Program (version 4.2 14/11/90 IBM PC/XT/PS2)	
<p>Please prepare to Download from the Hand Held Gas Readout :-</p> <ol style="list-style-type: none"> <li>1) Switch on the unit.</li> <li>2) Connect RS-232 link.</li> <li>3) Press Key "0"</li> <li>4) Enter RS-232 Mode by pressing Key "4"</li> <li>5) Wait for data to be received.</li> </ol> <p>Waiting</p>	<p>Readings Downloaded</p> <p>00150</p>
Geo Group Inc.	
Press ESC to abort.	

## Gas Analyser Operation

(Appears  
for 5  
seconds)

**WARNING!-Do NOT use  
in confined spaces.  
-unit NOT certified  
intrinsically safe.**

Geo Group Inc.  
I-R Gas Analyser  
1/6 Contrast 0-Exit

Press 0

1 - General Utilities  
2 - Read Gas Levels  
3 - View/Print Data  
4 - Download Data

Press 4

RS-232 Mode  
Awaiting Instruction  
from computer

Downloading Data

Cont. on next page



Continued from previous page

Downloading is now complete,  
but data is not yet stored to disc  
- choose to store all data or  
selected data to disc.

Continued from previous page

Universal Download Program (version 4.2 14/11/80 IBM PC/XT/PS2)

Please prepare to Download from the Hand Held Gas Readout :-

- 1) Switch on the unit.
- 2) Connect RS-232 link.
- 3) Press Key "0"
- 4) Enter RS-232 Mode by pressing Key "4"
- 5) Wait for data to be received.

Press RETURN to download all data from the Unit. Press "7" to examine data. It is also possible to store only data based on the following :- borehole, time and date. Using the ← → keys position the cursor then enter the correct digit. Only files where the data entered corresponds to the data in a file will be downloaded. Where "X" equals any digit.

Code	Time	Date
X000X X000X	X000X	X0/X0/X0X

Geo Group Inc.

Use cursor keys to scan data. Press ESC to file selection.

Press ? - to view the data  
downloaded (but not yet  
stored to disc)

Press Return to  
store all data to  
disc.

Enter specific  
identity code and or  
time/date to store  
selected data. Press  
Return to enter.

Enter Filename with extension  
(and directory path if required).

Universal Download Program (version 4.2 14/11/80 IBM PC/XT/PS2)

Please prepare to Download from the Hand Held Gas Readout :-

- 1) Switch on the unit.
- 2) Connect RS-232 link.
- 3) Press Key "0"
- 4) Enter RS-232 Mode by pressing Key "4"
- 5) Wait for data to be received.

Press RETURN to download all data from the Unit. Press "7" to examine data. It is also possible to store only data based on the following :- borehole, time and date. Using the ← → keys position the cursor then enter the correct digit. Only files where the data entered corresponds to

Filename: \_\_\_\_\_

Code	Time	Date
X000X X000X	X000X	X0/X0/X0X

Geo Group Inc.

Press RETURN to complete. Press ESC to abort.

Press Enter

Data Stored to disc

Select more data for  
storing to disc.

Press ESC key to return to main menu  
and disconnect Gas Analyzer. This  
completes the download operation.

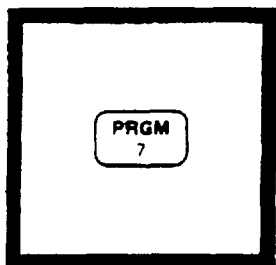
- 1 - General Utilities
- 2 - Read Gas Levels
- 3 - View/Print Data
- 4 - Download Data

## **HACH DR/820 COLORIMETER**

## Method 8146

**IRON, FERROUS** (0 to 3.00 mg/L)

For water, wastewater, and seawater

**1,10 Phenanthroline Method\*** (Powder Pillows or AccuVac Ampuls)**Using Powder Pillows**

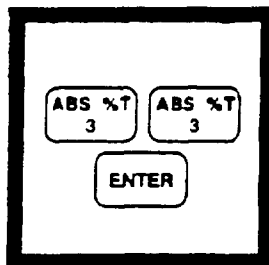
1. Enter the stored program number for Ferrous iron ( $\text{Fe}^{2+}$ )-powder pillows.

Press: **PRGM**

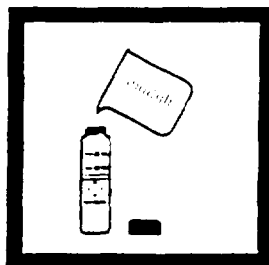
The display will show:

**PRGM ?**

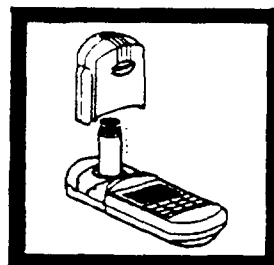
*Note: Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric iron, which is not determined.*



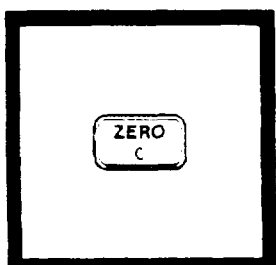
2. Press: **33 ENTER**  
The display will show mg/L, Fe and the ZERO icon.



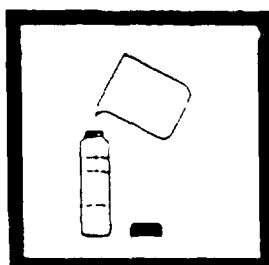
3. Fill a sample cell with 25 mL of sample (the blank).



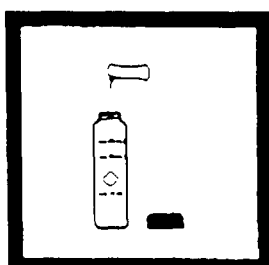
4. Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.



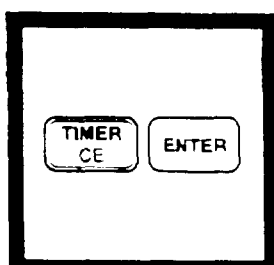
5. Press: **ZERO**  
The cursor will move to the right, then the display will show:  
**0.00 mg/L Fe**



6. Fill another sample cell with 25 mL of sample.



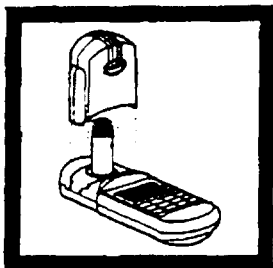
7. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Cap and invert to mix.  
*Note: Undissolved powder does not affect accuracy.*



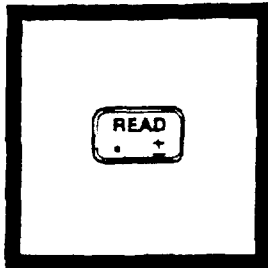
8. Press: **TIMER ENTER**  
A three-minute reaction period will begin.  
*Note: An orange color will form if ferrous iron is present.*

\* Adopted from *Standard Methods for the Examination of Water and Wastewater*

## IRON, FERROUS, continued



9. Place the prepared sample into the cell holder. Tightly cover the sample cell with the instrument cap.

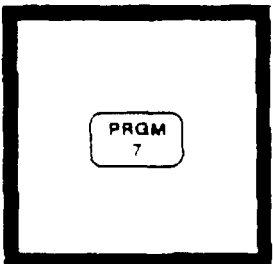


10. Press: **READ**

The cursor will move to the right, then the result in mg/L ferrous iron will be displayed.

*Note: Standard Adjust may be performed using a prepared standard (see Section 1).*

### Using AccuVac Ampuls



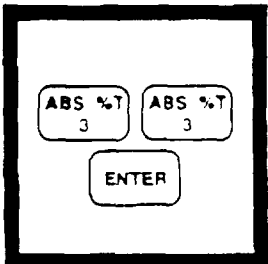
1. Enter the stored program number for ferrous iron ( $\text{Fe}^{2+}$ )-AccuVac ampuls.

Press: **PRGM**

The display will show:

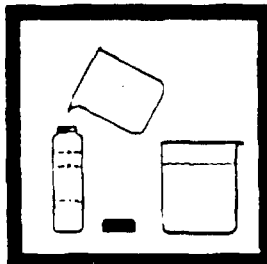
**PRGM ?**

*Note: Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric, which is not determined.*

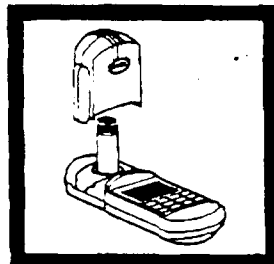


2. Press: **33 ENTER**

The display will show mg/L, Fe and the **ZERO** icon.

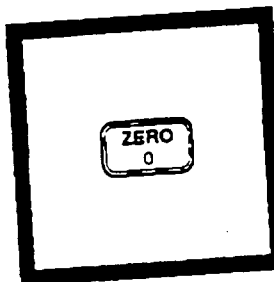


3. Fill a sample cell with at least 10 mL of sample (the blank). Collect at least 40 mL of sample in a 50-mL beaker.



4. Place the blank into the cell holder. Tightly cover the sample cell with the instrument cap.

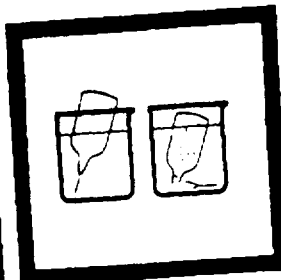
## IRON, FERROUS, continued



### 5. Press: ZERO

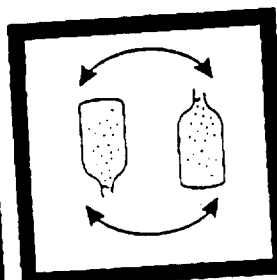
The cursor will move to the right, then the display will show:

0.00 mg/L Fe



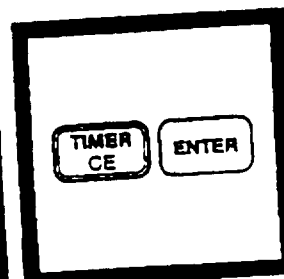
### 6. Fill a Ferrous Iron AccuVac Ampul with sample.

*Note: Keep the tip immersed while the ampul fills completely.*



### 7. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

*Note: Undissolved powder does not affect accuracy.*

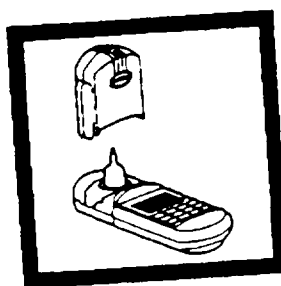


### 8. Press:

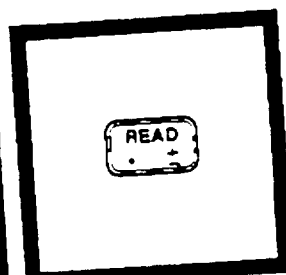
**TIMER ENTER**

A three-minute reaction period will begin.

*Note: An orange color will form if ferrous iron is present.*



### 9. Place the AccuVac ampul into the cell holder. Tightly cover the sample cell with the instrument cap.



### 10. Press: READ

The cursor will move to the right, then the result in mg/L ferrous iron will be displayed.

*Note: Standard Adjust may be performed using a prepared standard (see Standard Adjust in Section 1).*

## IRON, FERROUS, continued

---

### Sampling and Storage

Ferrous iron must be analyzed immediately and cannot be stored. Analyze samples as soon as possible to prevent oxidation of ferrous iron to ferric iron, which is not measured.

### Accuracy Check

#### Standard Solution Method

Prepare a ferrous iron stock solution (100 mg/L  $\text{Fe}^{2+}$ ) by dissolving 0.7022 grams of ferrous ammonium sulfate, hexahydrate, in deionized water. Dilute to 1 liter. Prepare immediately before use. Dilute 1.00 mL of this solution to 100 mL with deionized water to make a 1.00 mg/L standard solution. Prepare immediately before use.

Run the test using the 1.00 mg/L  $\text{Fe}^{2+}$  Standard Solution by following either the powder pillow or AccuVac procedure. Results should be between 0.90 mg/L and 1.10 mg/L  $\text{Fe}^{2+}$ .

### Method Performance

#### Precision

In a single laboratory using an iron standard solution of 2.00 mg/L  $\text{Fe}^{2+}$  and two representative lots of powder pillow reagents with the instrument, a single operator obtained a standard deviation of  $\pm 0.017$  mg/L  $\text{Fe}^{2+}$ .

In a single laboratory using a standard solution of 2.00 mg/L  $\text{Fe}^{2+}$  and two representative lots of AccuVac ampuls with the instrument, a single operator obtained a standard deviation of  $\pm 0.009$  mg/L  $\text{Fe}^{2+}$ .

#### Estimated Detection Limit

The estimated detection limit for program 33 (powder pillows and AccuVac Ampuls) is 0.03 mg/L Fe. For more information on the estimated detection limit, see *Section 1*.

### Summary of Method

The 1,10-phenanthroline indicator in Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron ( $\text{Fe}^{3+}$ ) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

**IRON, FERROUS, continued****REQUIRED REAGENTS & APPARATUS (USING POWDER PILLOWS)**

Description	Quantity Required		Units	Cat. No.
	Per Test			
Ferrous Iron Reagent Powder Pillows.....	1 pillow.....	100/pkg.....		1037-49
Sample Cell, 10-20-25 mL, w/ cap .....		6/pkg.....		24019-00

**REQUIRED REAGENTS & APPARATUS (USING ACCUVAC AMPULS)**

Ferrous Iron Reagent AccuVac Ampuls.....	1 ampul.....	25/pkg.....		25140-25
Beaker, 50 mL .....	1 .....	each.....		500-41

**OPTIONAL REAGENTS**

Ferrous Ammonium Sulfate, hexahydrate .....	113g.....			11256-14
Water, deionized .....	4 L .....			272-56

**OPTIONAL APPARATUS**

AccuVac Snapper Kit .....	each.....			24052-00
Balance, analytical, 115 V .....	each.....			26103-00
Balance, analytical, 230 V .....	each.....			26103-02
Clippers, for opening powder pillows .....	each.....			968-00
Flask, volumetric, 100 mL, Class A .....	each.....			14574-42
Flask, volumetric, 1000 mL, Class A .....	each.....			14574-53
Pipet, volumetric, Class A, 1.00 mL .....	each.....			14515-35
Pipet Filler, safety bulb .....	each.....			14651-00
Weighing Boat .....	500/pkg.....			21790-00

***For Technical Assistance, Price and Ordering***

In the U.S.A.—Call 800-227-4224

Outside the U.S.A.—Contact the Hach office or distributor serving you.

## Health and Safety Plan



**DRAFT HEALTH AND SAFETY PLAN FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

**DRAFT HEALTH AND SAFETY PLAN FOR  
BLACKWELL FOREST PRESERVE LANDFILL  
DuPAGE COUNTY, ILLINOIS**

**Prepared for  
U.S. Environmental Protection Agency  
Region 5  
Chicago, Illinois**

Work Assignment No.	:	84-5P6Y
Contract No.	:	68-W8-0084
Tetra Tech No.	:	030-008401RA
EPA Work Assignment Manager	:	Michael Bellot
Telephone No.	:	(312) 353-6425
Date Prepared	:	January 22, 1998
Prepared by	:	Tetra Tech EM Inc. (Judy Wagner)
Tetra Tech Site Manager	:	Kostas Dovantzis
Telephone No.	:	(312) 856-8757



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

<b>Site Name:</b> Blackwell Forest Preserve Landfill (Blackwell)	<b>Site Contact:</b> DuPage County Forest Preserve District (FPD)	<b>Telephone:</b> (630) 790-4900															
<b>Location:</b> Winfield Township, DuPage County	<b>EPA Contact:</b> Michael Bellot	<b>Telephone:</b> (312) 353-6425															
<b>EPA I.D. No.:</b> ILD 980 606 305	<b>Prepared By:</b> Judy Wagner	<b>Date:</b> 01/20/98															
<b>Project No.:</b> 030-008401RA																	
<b>Date of Proposed Activities:</b> March 1998																	
<b>Objectives:</b>  Tetra Tech EM Inc. (Tetra Tech) will oversee operations by the contractor for FPD during (1) investigation of the north storm water collection pipe, (2) remedial action (RA) activities, and (3) quarterly groundwater monitoring sampling. Soil, surface water, and sediment split samples will be collected. Tetra Tech will oversee the collection of these samples and obtain split samples. In addition, Tetra Tech will collect groundwater and leachate samples for analysis of volatile organic compounds (VOC), semivolatile organic compounds, and geochemical indicator parameters as described in the field sampling plan and will measure methane, carbon dioxide, and oxygen in soil gas to assist EPA in evaluating the rate of in situ degradation (natural attenuation) at the site.	<b>Site Type: Check as many as applicable.</b>  <table style="width: 100%;"> <tr> <td><input type="checkbox"/> Active</td> <td><input checked="" type="checkbox"/> Landfill</td> <td><input type="checkbox"/> Unknown</td> </tr> <tr> <td><input checked="" type="checkbox"/> Inactive</td> <td><input type="checkbox"/> Uncontrolled</td> <td><input type="checkbox"/> Gasoline service station</td> </tr> <tr> <td><input type="checkbox"/> Secure</td> <td><input type="checkbox"/> Industrial</td> <td><input type="checkbox"/> Other (specify) _____</td> </tr> <tr> <td><input type="checkbox"/> Unsecure</td> <td><input type="checkbox"/> Recovery</td> <td></td> </tr> <tr> <td><input type="checkbox"/> Enclosed space</td> <td><input type="checkbox"/> Well Field</td> <td></td> </tr> </table>		<input type="checkbox"/> Active	<input checked="" type="checkbox"/> Landfill	<input type="checkbox"/> Unknown	<input checked="" type="checkbox"/> Inactive	<input type="checkbox"/> Uncontrolled	<input type="checkbox"/> Gasoline service station	<input type="checkbox"/> Secure	<input type="checkbox"/> Industrial	<input type="checkbox"/> Other (specify) _____	<input type="checkbox"/> Unsecure	<input type="checkbox"/> Recovery		<input type="checkbox"/> Enclosed space	<input type="checkbox"/> Well Field	
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<input type="checkbox"/> Unsecure	<input type="checkbox"/> Recovery																
<input type="checkbox"/> Enclosed space	<input type="checkbox"/> Well Field																
<b>Site Description and History:</b> The Blackwell site is located in Section 26, Township 39 North, Range 9 East, DuPage County, Illinois. The Blackwell site is part of the Blackwell Forest Preserve and is owned by FPD, the potentially responsible party (PRP) for the site. The landfill occupies approximately 40 acres within the Blackwell Forest Preserve. A hill more than 100 feet above ground level is present at the site. The hill and lakes (former gravel pits) at the site are now a recreational area. Contaminants are migrating from the landfill into groundwater and toward nearby drinking water wells. There is no known surface water contamination. Leachate and landfill gas pose the most significant risks to human health and the environment.  Landfill construction began in 1965. The original landfill design called for a series of 1-acre, clay-lined cells to be built with a leachate collection system. Upon the completion of each cell, clay covers and side berms would be constructed for the next level of refuse. The clay covers served as the liners for the overlying cells as landfill construction proceeded upward. Significant deviations from the original design are known to have occurred, including the addition of at least one cell, lack of a clay liner in one cell, lack of the leachate collection system, and cells considerably larger than 1 acre. The cover material ranges from 2 to 60 feet thick. In addition to clay, the cover also contains topsoil, silt fill, sand and gravel fill, gravel fill, and some refuse.  The site was proposed for inclusion on the National Priorities List (NPL) in June 1988. It was placed on the NPL in February 1990. In accordance with an administrative order by consent (AOC) signed by EPA and FPD in September 1989, FPD conducted a remedial investigation and feasibility study to determine the nature and extent of contamination, assess risks to human health and the environment, and evaluate technologies for landfill closure. Based on the remedial investigation results, various petroleum-related and chlorinated VOCs have been detected in groundwater downgradient from the landfill on FPD property. Two monitoring wells near FPD's property line exceeded maximum contaminant levels during one sampling event. In addition, three contaminants detected in private wells downgradient from the site were among five contaminants detected in bedrock monitoring wells downgradient from the landfill. These private wells draw groundwater from the bedrock aquifer. In March 1996, FPD and EPA signed a new AOC that will specify remedial design and RA activities for landfill closure.																	

**HEALTH AND SAFETY PLAN****Waste Management Practices:**

The landfill accepted approximately 1.5 million cubic yards of household refuse and light industrial waste from about 1965 through 1973. Some refuse may have been incorporated in the cover material until 1975. Wastes disposed of at the landfill include 8,000 tons of dry sludge from the Metropolitan Water Reclamation District of Greater Chicago; daily trash from Owens-Illinois of St. Charles, Illinois, a glass manufacturing facility; and trash of unknown composition from Kroehler Manufacturing of Naperville, Illinois. Approximately 3 to 4 tons of refuse per day were disposed of in the landfill.

**Waste Types:** ☒ Liquid ☒ Solid ☒ Sludge ☒ Gas ☐ Unknown ☐ Other

**Waste Characteristics:**

☐ Corrosive ☒ Flammable ☐ Radioactive  
☒ Toxic ☒ Volatile ☐ Unknown  
☐ Inert ☐ Reactive ☐ Other  
☐ Ignitable

**Hazards of Concern:**

☐ Heat stress ☐ Buried utilities  
☒ Cold stress ☐ Overhead utilities  
☒ Explosive/flammable ☐ Biological  
☐ Oxygen deficient ☐ Noise  
☐ Radiological ☐ Inorganic chemicals  
☐ Underground storage tanks ☒ Organic chemicals  
☐ Surface tanks ☒ Heavy equipment  
☐ Other (specify) \_\_\_\_\_

**Fire or Explosion Potential:** ☐ High ☒ Medium ☐ Low ☐ Unknown



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

Chemical Products Tetra Tech EM Inc. Will Use or Store On Site (Attach a Material Safety Data Sheet [MSDS] for each item)

☒ Alconox

☒ Nitric acid

☒ Sulfuric acid

☐ Sodium hydroxide

☒ Other (specify) Hydrochloric acid

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

☐ Other (specify) \_\_\_\_\_

## HEALTH AND SAFETY PLAN

Chemicals Present at Site	Highest Observed Concentration (specify units and media)	PEL/TLV (specify ppm or mg/m <sup>3</sup> )	IDLH (specify ppm or mg/m <sup>3</sup> )	Symptoms and Effects of Acute Exposure	Photo-ionization Potential (eV)
<b>Leachate</b>					
2-Butanone	17,000 µg/L	200 ppm	3,000 ppm	CNS depression; irritates eyes, skin, and nose; headache and dizziness; dermatitis	9.54
Acetone	10,000 µg/L	1,000 ppm	2,500 ppm	CNS depression; irritates eyes, nose, and throat; headache and dizziness; dermatitis	9.69
4-Methylphenol (p-cresol)	17,000 µg/L	5 ppm	250 ppm	Irritates eyes, skin, and mucus membranes; CNS effects; pancreas damage	8.97
1,4-Dichlorobenzene	940 µg/L	75 ppm	150 ppm	Irritates eyes; profuse rhinitis; headache; liver and kidney injury; CARC	8.98
Trichloroethene	720 µg/L	100 ppm	1,000 ppm	CNS depression; irritates eyes and skin; headache; liver injury; CARC	9.45
<b>Landfill gas</b>					
Toluene	92 ppm	200 ppm	500 ppm	CNS depression; irritates eyes and nose; fatigue; weakness; liver and kidney damage	8.82
1,2-Dichloroethene	46 ppm	200 ppm	1,000 ppm	CNS depression; irritates eyes and respiratory system	9.65
Trichloroethene	28 ppm	100 ppm	1,000 ppm	CNS depression; irritates eyes and skin; headache; fatigue; liver injury; CARC	9.45
Vinyl chloride	21 ppm	1 ppm	No data	CNS depression; weakness; abdominal pain; enlarged liver; CARC	9.99
Xylenes	17 ppm	100 ppm	900 ppm	CNS depression; irritates eyes, skin, throat, and nose; dizziness; dermatitis	8.56
Methylene chloride	17 ppm	500 ppm	2,300 ppm	CNS depression; irritates eyes and skin; fatigue; CARC	11.32
Tetrachloroethene	17 ppm	100 ppm	150 ppm	CNS depression; irritates eyes, nose, and throat; nausea; dizziness; headache; CARC	9.32

**Notes:** Table represents chemicals found in significant quantities on several occasions. Source: Warzyn. 1994. Final Remedial Investigation Report for Blackwell Landfill NPL Site. December

CARC = Carcinogenic  
CNS = Central nervous system  
eV = Electron volt

IDLH = Immediately dangerous to life or health  
mg/m<sup>3</sup> = Milligram per cubic meter  
PEL = Permissible exposure limit

ppm = Part per million  
TLV = Threshold limit value  
µg/L = Microgram per liter



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

Field Activities Covered Under This Plan				
Task Description	Type	Level of Protection		Date of Activities
		Primary	Contingency	
1 Observe RA field activities and investigation of the north storm water pipe; observe quarterly monitoring sampling; and observe collection of samples of leachate, groundwater, soil, surface water, and sediment	<input type="checkbox"/> Intrusive <input checked="" type="checkbox"/> Nonintrusive	<input type="checkbox"/> C <input checked="" type="checkbox"/> D <input type="checkbox"/> Modified	<input checked="" type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> Modified	March 1998
2 Collect groundwater and leachate samples, and measure methane, carbon dioxide, and oxygen in soil gas; obtain split samples of surface water, sediment, and soil	<input checked="" type="checkbox"/> Intrusive <input type="checkbox"/> Nonintrusive	<input type="checkbox"/> C <input checked="" type="checkbox"/> D <input type="checkbox"/> Modified	<input checked="" type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> Modified	March 1998

Site Personnel and Responsibilities (include subcontractors)		
Employee Name and Office Code	Task	Responsibilities
Kevin Schnoes (Field Team Leader and Site Health and Safety Officer (SHSO))	1, 2	<p>Field Team Leader: Directs field investigation activities, makes site manager aware of pertinent project developments and plans, and maintains communications with client as necessary.</p> <p>SHSO: Ensures appropriate personal protective equipment (PPE) is available and enforces proper utilization of PPE by on-site personnel, suspends investigative work if believes site personnel are or may be exposed to an immediate health hazard, implements the health and safety plan, and reports to EPA and site manager any observed deviations from anticipated conditions described in the plan.</p>
Eric Monschein (Field personnel)	1, 2	Field Personnel: Completes tasks as directed by site manager, field team leader, and SHSO. Follows all procedures and guidelines established in the Tetra Tech health and safety program plan.
Kostas Dovantzis (Site Manager)	1, 2	Site Manager: Directs all project investigation activities



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

### PROTECTIVE EQUIPMENT: *Indicate type or material as necessary for each task.*

Tasks: ☒ 1 ☒ 2  
Level: ☐ C ☒ D ☐ Modified  
☒ Primary ☐ Contingency

#### RESPIRATORY

☒ Not Needed

☐ APR: \_\_\_\_\_

☐ Cartridge: \_\_\_\_\_

☐ Escape Mask: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### PROTECTIVE CLOTHING

☐ Not Needed

☒ Tyvek Coverall: \_\_\_\_\_

☐ Saranex Coverall: \_\_\_\_\_

☐ Coverall: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### HEAD AND EYE

☐ Not Needed

☒ Safety Glasses: \_\_\_\_\_

☐ Face Shield: \_\_\_\_\_

☐ Goggles: \_\_\_\_\_

☒ Hard Hat: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### GLOVES

☐ Not Needed

☒ Undergloves: N-DEX

☐ Gloves: \_\_\_\_\_

☐ Overgloves: \_\_\_\_\_

#### FIRST AID EQUIPMENT

☐ Not Needed

☒ Standard First Aid Kit

☐ Portable Eyewash

#### BOOTS

☐ Not Needed

☒ Boots: Steel Toe/Steel Shank

☒ Overboots: Optional

#### OTHER

☐ Not Needed

☒ (specify): Cold-weather gear

Tasks: ☒ 1 ☒ 2  
Level: ☒ C ☐ D ☐ Modified  
☐ Primary ☒ Contingency

#### RESPIRATORY

☐ Not Needed

☒ APR: Full-face

☒ Cartridge: GMA-H

☐ Escape Mask: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### PROTECTIVE CLOTHING

☐ Not Needed

☒ Tyvek Coverall: \_\_\_\_\_

☐ Saranex Coverall: \_\_\_\_\_

☐ Coverall: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### HEAD AND EYE

☐ Not Needed

☒ Safety Glasses: \_\_\_\_\_

☐ Face Shield: \_\_\_\_\_

☐ Goggles: \_\_\_\_\_

☒ Hard Hat: \_\_\_\_\_

☐ Other: \_\_\_\_\_

#### GLOVES

☐ Not Needed

☒ Undergloves: N-DEX

☐ Gloves: \_\_\_\_\_

☐ Overgloves: \_\_\_\_\_

#### FIRST AID EQUIPMENT

☐ Not Needed

☒ Standard First Aid Kit

☐ Portable Eyewash

#### BOOTS

☐ Not Needed

☒ Boots: Steel Toe/Steel Shank

☒ Overboots: Optional

#### OTHER

☐ Not Needed

☒ (specify): Cold-weather gear



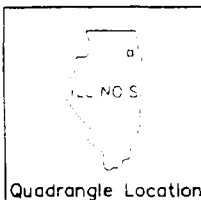
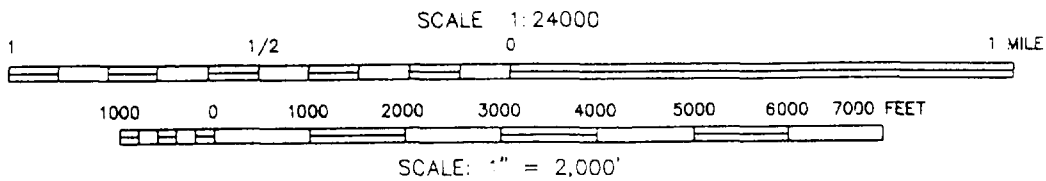
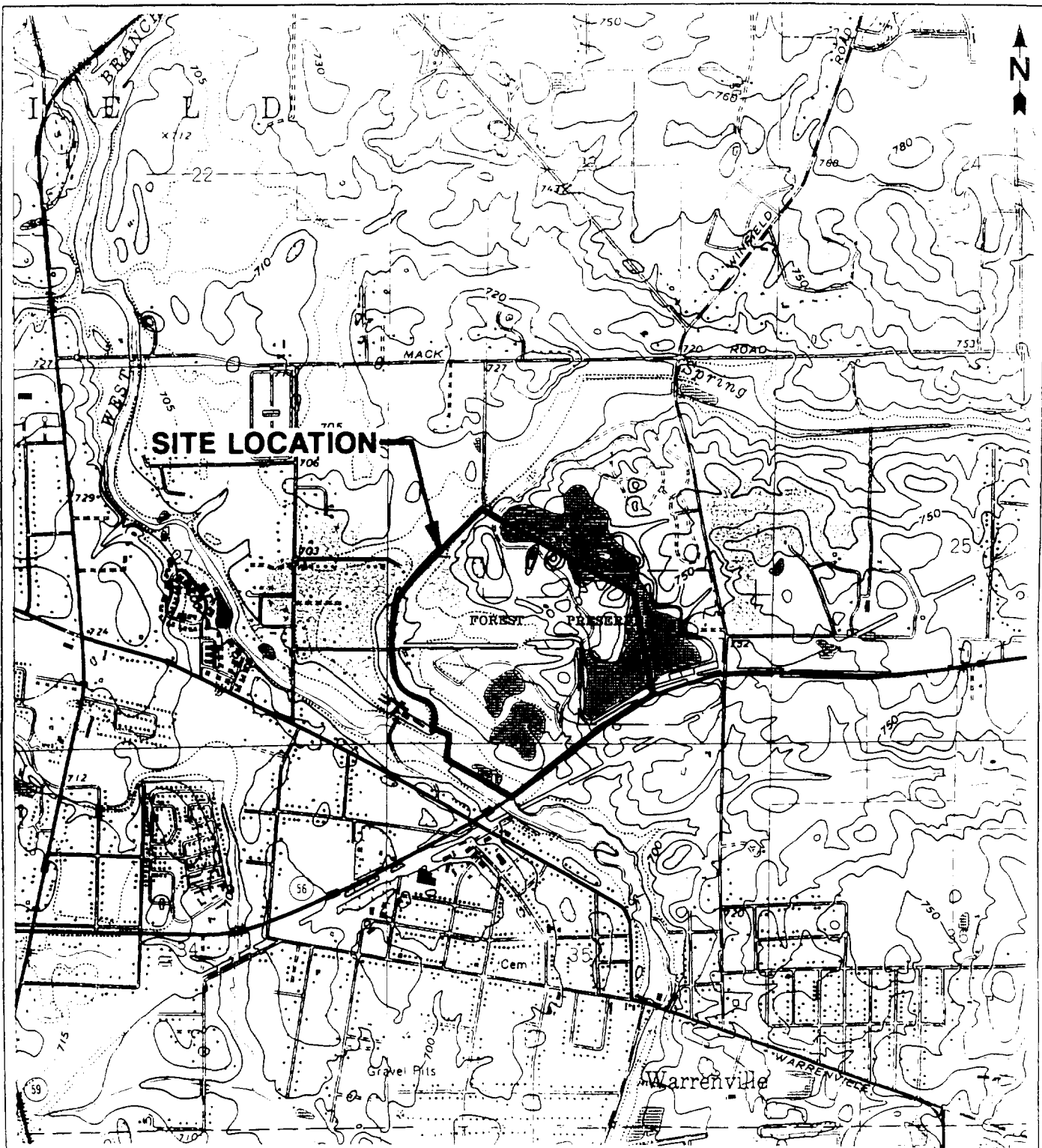
## HEALTH AND SAFETY PLAN

Monitoring Equipment: <i>Specify instruments needed for each task. Attach additional sheets, as necessary.</i>				
Instrument	Tasks	Instrument Reading	Action Guidelines	Comments
Combustible gas indicator Type: Landtech GA90	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2	0 - 10% LEL 10 - 25% LEL > 25% LEL	No explosion hazard Potential explosion hazard; notify SHSO Explosion hazard; interrupt task; evacuate site	<input type="checkbox"/> Not Needed
O <sub>2</sub> meter Type: Landtech GA90	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2	> 23.5% O <sub>2</sub> 23.5 - 19.5% O <sub>2</sub> < 19.5% O <sub>2</sub>	Potential fire hazard; evacuate site Oxygen normal Oxygen deficient; stop task; evacuate site; notify SHSO	<input type="checkbox"/> Not Needed
Radiation survey meter Type:	<input type="checkbox"/> 1 <input type="checkbox"/> 2	< 2 mrem per hour 3 x Background > 2 mrem per hour	Normal background Notify SHSO Interrupt task and evacuate site	Note: Annual exposure not to exceed 1,250 mrem per quarter <input checked="" type="checkbox"/> Not Needed
Photoionization detector  <input type="checkbox"/> 11.7 eV <input checked="" type="checkbox"/> 10.2 eV <input type="checkbox"/> 9.8 eV <input type="checkbox"/> _____ eV Type: Photovac 2020 or mini RAE (survey model)	<input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2	Specify:  > 0 - 5 ppm above background > 5 ppm to 20 ppm above background > 20 ppm above background	Level D Level C Evacuate site	<input type="checkbox"/> Not Needed
Flame ionization detector Type:	<input type="checkbox"/> 1 <input type="checkbox"/> 2	Specify:		<input checked="" type="checkbox"/> Not Needed
Detector tubes Type: Type:	<input type="checkbox"/> 1 <input type="checkbox"/> 2	Specify:		<input checked="" type="checkbox"/> Not Needed
Respirable dust monitor Type:	<input type="checkbox"/> 1 <input type="checkbox"/> 2	Specify:		<input checked="" type="checkbox"/> Not Needed
Other Specify:	<input type="checkbox"/> 1 <input type="checkbox"/> 2	Specify:		<input checked="" type="checkbox"/> Not Needed

Notes: eV = Electron volt    LEL = Lower explosive limit    mrem = Millirem    O<sub>2</sub> = Oxygen    ppm = Part per million

**HEALTH AND SAFETY PLAN**

Contingency Plan	Emergency Contacts	Telephone
Follow lead of contractor for PRP or leave site	U.S. Coast Guard National Response Center	1-800/424-8801
	Human Resources: Kate Gilmore	1-303/295-1101
	Health & Safety Director: Judy Wagner	1-847/255-4166
	CHEMTREC	1-800/424-9300
	Office Health and Safety Coordinator: Carrie Haag	(312) 856-8700
	Site Manager: Kostas Dovantzis	(312) 856-8700
	Site Health and Safety Officer: Kevin Schnoes	(312) 856-8700
	Fire Department	911
	Police Department	911
Personnel Decontamination and Disposal Method	MEDICAL EMERGENCY	
<p>Personnel will follow EPA's Standard Operating Safety Guides for decontamination procedures for modified Level D personnel protection (with modified Level C contingency). The following decontamination stations should be set up in a decontamination zone:</p> <ul style="list-style-type: none"> <li>• Segregated equipment drop</li> <li>• Boot and glove wash and rinse</li> <li>• Disposable glove, bootie, and overall (if Tyvek® is used) removal and segregation</li> <li>• Safety glasses and hard hat removal</li> <li>• Hand and face wash and rinse.</li> </ul> <p>If site conditions require upgrade to Level C, a station must be set up for respirator removal, decontamination, and cartridge disposal.</p> <p>All disposable equipment, clothing, and wash water will be double-bagged or containerized and disposed of by FPD personnel.</p>	Hospital	Central DuPage Hospital
	Hospital Address	25 North Winfield Road, Winfield
	Hospital Telephone	Emergency - (630) 260-2600 General - (630) 682-1600
	Ambulance	911
	Route to hospital (see Page 10 for route map)	
	At Blackwell Forest Preserve entrance, turn left on Butterfield Road. After 0.3 mile, turn left (north) on Winfield Road. About 3 miles later, cross C&NW tracks at Winfield Station. Continue north on Winfield Road 0.25 mile, and turn right into Central DuPage Hospital.	

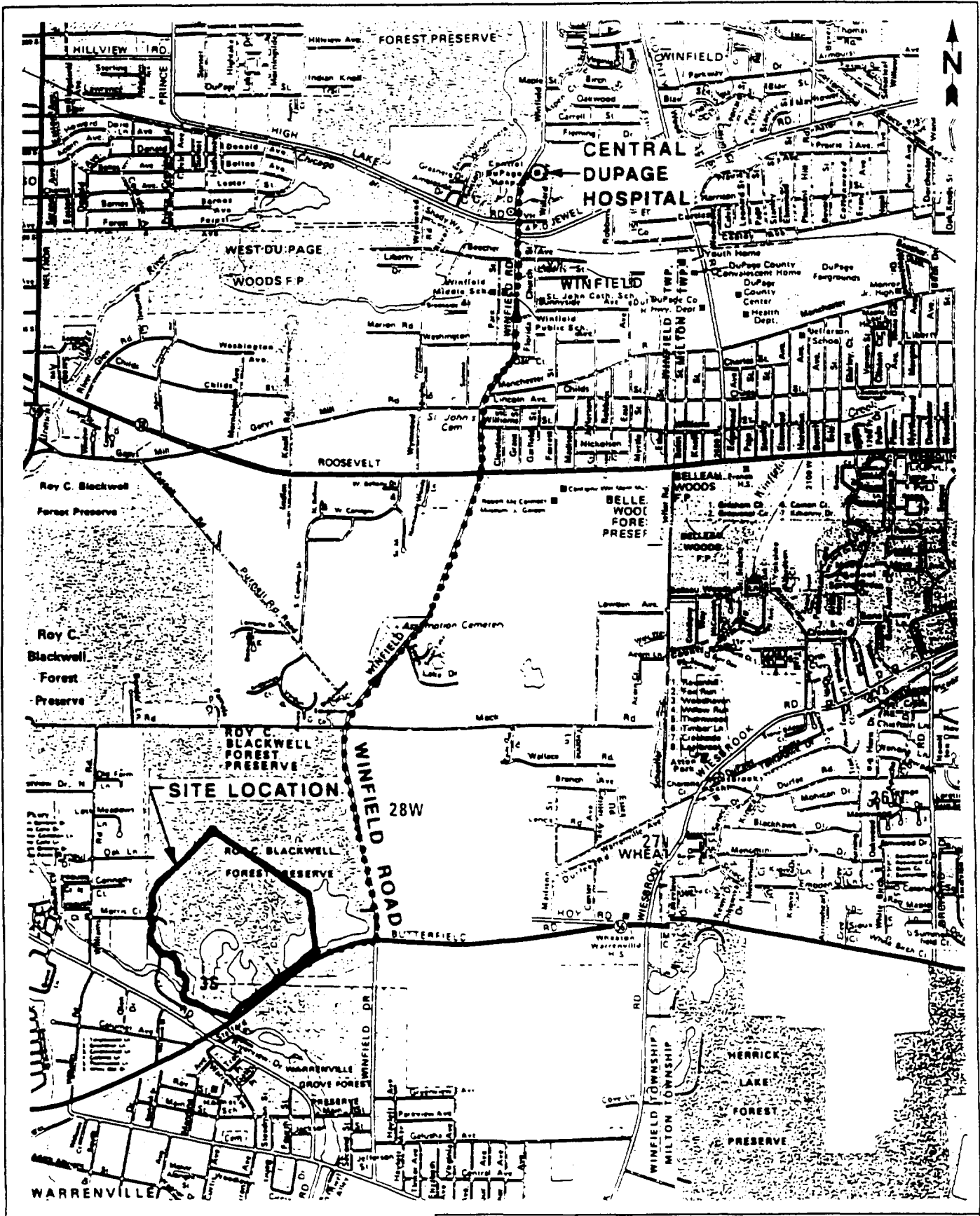


BLACKWELL FOREST PRESERVE LANDFILL  
DU PAGE COUNTY, ILLINOIS

**FIGURE 1**  
**SITE LOCATION**

SOURCE: MODIFIED FROM USGS,  
NAPERVILLE, ILLINOIS, QUADRANGLE, 1980

**Tt Tetra Tech EM Inc.**



1/4 MILE 0 1/4 MILE 1/2 MILE  
 SCALE: 1" = 1/2 MILE

SOURCE: MODIFIED FROM CHICAGO LAND ATLAS, 1990



Map Location

BLACKWELL FOREST PRESERVE LANDFILL  
 DU PAGE COUNTY, ILLINOIS

**FIGURE 2**  
**HOSPITAL ROUTE MAP**

 **Tetra Tech EM Inc.**



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

### APPROVAL AND SIGN-OFF FORM

**Project No. 030-008401RA**

*I have read, understood, and agree with the information set forth in this Health and Safety Plan and will follow the direction of the Site Health and Safety Officer as well as procedures and guidelines established in the Tetra Tech EM Inc. Health and Safety Program Plan. I understand the training and medical requirements for conducting field work and have met these requirements.*

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**APPROVALS:** *(Two Signatures Required)*

\_\_\_\_\_  
Site Health and Safety Officer

\_\_\_\_\_  
Date

\_\_\_\_\_  
Health and Safety Director or Designee

\_\_\_\_\_  
Date



Tetra Tech EM Inc.

## HEALTH AND SAFETY PLAN

### DEFINITIONS

**Intrusive** - Work involving excavation to any depth, drilling, opening of monitoring wells, most sampling, and Geoprobe® work

**Nonintrusive** - Generally refers to site walk-throughs or field reconnaissance

#### Levels of Protection

**Modified Level D** - Hard hat, safety boots, and glasses

**Level D** - Items listed for modified Level D above, **PLUS** protective clothing such as gloves, boot covers, and Tyvek® or Saranex® coveralls

**Modified Level C** - Hard hat, safety boots, glasses, and air purifying respirators with appropriate cartridges

**Level C** - Items listed for modified Level C above, **PLUS** protective clothing such as gloves, boot covers, and Tyvek® or Saranex® coveralls

#### Emergency Contacts

**CHEMTREC** - For issues related to incidents involving the transportation of hazardous chemicals; this hotline provides accident assistance 24 hours per day, 7 days per week

**U.S. Coast Guard National Response Center** - For issues related to spill containment, cleanup, and damage assessment; this hotline will direct spill information to the appropriate state or region

#### Health and Safety Plan Short Form

- Used for field projects of limited duration and with relatively limited activities; may be filled in with handwritten text
- Limitations:
  - No Level B or A work
  - No more than two tasks
  - No confined space entry
  - No unexploded ordnance work

**ATTACHMENT A**

**DAILY SITE LOG**

(One Sheet)

**Tetra Tech EM Inc.**

DAILY SITE LOG FOR

SITE/FACILITY NAME

CONTRACT NO.

PERSONAL  
PROTECTION  
LEVEL

## ACTIVITY DESCRIPTIONS

I.		
II.		
III.		
IV.		
V.		

**Instructions:** Mark an "X" in the box(es) corresponding to the hour(s) you work on a specific activity. Round off partial hours, and total your hours daily. For example, if you work on Activity I from 8:00 a.m. to 11:15 a.m., then work on Activity II from 1:00 p.m. to 4:30 p.m., you would round off the 11:15 to 11:00 and the 4:30 to 5:00. You would place an "X" in the following boxes: Activity I—8-9, 9-10, and 10-11; Activity II—1-2, 2-3, 3-4, and 4-5. Your daily totals would be 3 for Activity I and 4 for Activity II.

H O U R	Name:					Name:					Name:				
	Firm:					Firm:					Firm:				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
a.m.															
12 - 1															
1 - 2															
2 - 3															
3 - 4															
4 - 5															
5 - 6															
6 - 7															
7 - 8															
8 - 9															
9 - 10															
10 - 11															
11 - 12															
p.m.															
12 - 1															
1 - 2															
2 - 3															
3 - 4															
4 - 5															
5 - 6															
6 - 7															
7 - 8															
8 - 9															
9 - 10															
10 - 11															
11 - 12															
TOTAL															



**ATTACHMENT B**  
**MATERIAL SAFETY DATA SHEETS**  
(Five Sheets)

Page 1 of 2

## ALCONOX MATERIAL SAFETY DATA SHEET

ALCONOX, INC.

9 EAST 40th STREET SUITE 200

NEW YORK, NY 10016

(212)532-4040

24 HOUR EMERGENCY NUMBER (CHEM-TEL) (800)255-3324

04-322-4  
04-322-5A  
04-322-5B  
04-322-5C  
04-322-5D

## I - IDENTIFICATION

Product Name (As appears on label)

ALCONOX

CAS Registry Number

Not Applicable

Effective Date

September 1, 1993

Chemical Family

Anionic Powdered Detergent

## II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

## III - PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):

Not Applicable

Vapor Pressure (mm Hg):

Not Applicable

Vapor Density (Air=1):

Not Applicable

Specific Gravity (Water=1):

Not Applicable

Melting Point:

Not Applicable

Evaporation Rate (Butyl Acetate=1):

Not Applicable

Solubility in Water:

Appreciable - Soluble to 10% at ambient conditions

Appearance:

White Powder interspersed with cream colored flakes.

## IV - FIRE AND EXPLOSION DATA

Flash Point (Method Used): None

Flammable Limits:

LEL No Data

UFL No Data

Extinguishing Media: Water, dry chemical, CO<sub>2</sub>, foam

Special Firefighting Procedures:

Self-contained positive pressure breathing apparatus and protective clothing should be worn in fighting fires involving chemicals.

Unusual Fire and Explosion Hazards:

None

## V - REACTIVITY DATA

Stability:

Stable

Hazardous Polymerization:

Will not occur

Incompatibility (Materials to Avoid):

None

Hazardous Decomposition or Byproducts:

May release CO<sub>2</sub> on burning

Page 2 of 2

## VI - HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes

Skin? No

Ingestion? Yes

Health Hazards (Acute and Chronic): Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.

Carcinogenicity: NTP? No IARC Monographs? No OSHA Regulated? No

Signs and Symptoms of Exposure: Exposure may irritate mucous membranes. May cause sneezing.

Medical Conditions Generally Aggravated by Exposure: Not Established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.

Emergency and First Aid Procedures: Eyes-Immediately flush eyes with water for at least 15 minutes. Call a physician.  
Skin-Flush with plenty of water.  
Ingestion-Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs re administer fluids.  
See a physician for diagnosis.

## VII-PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled: Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.

Waste Disposal Method: Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.

Precautions to be Taken in Storing and Handling: Material should be stored in a dry area to prevent caking.

Other Precautions: No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

## VIII-CONTROL MEASURES

Respiratory Protection (Specify Type): Dust mask

Ventilation: Local Exhaust - Normal; Special - Not Required  
Mechanical - Not Required; Other - Not Required

Protective Gloves: Impervious Gloves are useful but not required

Eye Protection: Goggles are recommended when handling solutions.

Other Protective Clothing or Equipment: None

Work/Hygienic Practices: No special practices required

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## Material Safety Data Sheets Collection:

Sheet No. 9  
Sulfuric Acid, Concentrated

Issued: 10/77

Revision: D, 9/92

### Section 1. Material Identification

**Sulfuric Acid Concentrated ( $H_2SO_4$ )** Description: Prepared by the "Cat-Ox" process; by the contact process (vanadium pentoxide catalyst) with sulfur, pyrite ( $FeS_2$ ), hydrogen sulfide, or sulfur-containing smelter gases; and from gypsum (calcium sulfate). Sulfuric acid is by far the most widely used industrial chemical. Its uses include: in the manufacture of fertilizers, chemicals, nitrate explosives, parchment paper, glue, dyes and pigments; as an etchant, a lab reagent, an electrolyte in lead/acid batteries, a dehydrating agent in the manufacture of ethers and esters, and an alkylation catalyst; in the purification of petroleum, the refining of mineral and vegetable oils, the leather industry, the carbonization of wool fabrics, the recuperation of fatty acids from soapworks waste water, the production of rayon and film, the extraction of uranium from pitchblende, and pickling of metal; in electroplating baths, gas drying and nonferrous metallurgy; and to obtain glucose by the hydrolysis of cellulose.

**Other Designations:** CAS No. 7664-93-9, battery acid, BOV, Carwell No 815, dipping acid, electrolyte acid, hydrogen sulfate, matting acid, oil of vitriol, sulphuric acid, vitriol brown oil.

**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*<sup>(73)</sup> for a suppliers list.

**Cautions:** Handle concentrated sulfuric acid with extreme caution because it is corrosive to all body tissues. Vapor inhalation can cause severe lung damage. Skin or eye contact can produce severe burns; blindness may result.

R 1  
I 3  
S 4  
K 0



HMIS  
H 3\*  
F 0  
R 2  
PPE†  
\* Chronic effects  
† Sec. 8

### Section 2. Ingredients and Occupational Exposure Limits

Sulfuric acid concentrated, 93-98% sulfuric acid; remainder is water. Impurities include nonvolatiles, 0.02-0.03 ppm;  $SO_2$ , 40-80 ppm; iron, 50-100 ppm; nitrate, 5-20 ppm.

1991 OSHA PEL  
8-hr TWA: 1 mg/m<sup>3</sup>

1992-93 ACGIH TLVs

TWA: 1 mg/m<sup>3</sup>

STEL: 3 mg/m<sup>3</sup>

1990 IDLH Level  
80 mg/m<sup>3</sup>

1990 DFG (Germany) MAK

TWA: 1 mg/m<sup>3</sup>

1990 NIOSH REL  
TWA: 1 mg/m<sup>3</sup>

Category: Local irritants

Peak: 2 mg/m<sup>3</sup>, 5 min, momentary value<sup>†</sup>, 8 peaks per shift

1985-86 Toxicity Data\*

Human, inhalation,  $TC_{01}$ : 3 mg/m<sup>3</sup> for 24 weeks; toxic effects not yet reviewed.

Man, unreported route,  $LD_{50}$ : 135 mg/kg; toxic effects not yet reviewed.

Rat, oral,  $LD_{50}$ : 2140 mg/kg; toxic effects not yet reviewed.

Rabbit, eye: 100 mg rinse produced severe irritation.

\* See NIOSH, RTECS (WS5600000), for additional toxicity data.

† The momentary value is a level which the concentration should never exceed.

### Section 3. Physical Data

Boiling Point: 554 °F (290 °C); decomposes at 644 °F (340 °C) into sulfur trioxide and water.

Melting Point (100%): 50.65 °F (10.36 °C)

Vapor Pressure: <0.001 mm Hg at 20 °C

Saturated Vapor Density (air = 1.2 kg/m<sup>3</sup>): 1.2 kg/m<sup>3</sup>, 0.075 lbs/ft<sup>3</sup>

pH: 1 N sol = 0.3, 0.1 N sol = 1.2, 0.01 N sol = 2.1

Appearance and Odor: Colorless (pure) to dark brown (impure), odorless, dense, oily liquid. Pure compound is a solid below 51 °F (11 °C).

\* Sulfuric acid reacts violently with water with the evolution of heat. Always add the acid to water or other diluent, not the water to acid!

Molecular Weight: 98.08

Density/Specific Gravity (96-98%): 1.841

Water Solubility: Soluble; reacts!\*

Other Solubilities: Ethyl alcohol

Odor Threshold: 0.150 ppm

### Section 4. Fire and Explosion Data

Flash Point: Not combustible

Autoignition Temperature: None reported

LEL: None reported

UEL: None reported

**Extinguishing Media:** Use extinguishing media appropriate to surrounding fire. Only use water if absolutely necessary and use with great caution. Water applied directly to sulfuric acid results in violent heat liberation and splattering of the material. Use water spray only to keep fire-exposed containers cool. **Unusual Fire or Explosion Hazards:** Sulfuric acid, a strong dehydrating agent, reacts with organic materials and produces enough heat to ignite, chars wood, and may cause ignition of finely divided materials on contact. Reaction with metals may produce highly flammable, hydrogen gas. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is not effective. Stay away from ends of tanks. Do not release runoff from fire control methods to sewers or waterways.

### Section 5. Reactivity Data

**Stability/Polymertization:** Sulfuric acid is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Include acetic acid; acetone cyanohydrin; (acetone + nitric acid); (acetone + potassium dichromate); acetonitrile; acrolein; acrylonitrile; acrylonitrile + water; (alcohol + hydrogen peroxide); allyl alcohol; allyl chloride; ammonium hydroxide; 2-amino ethanol; ammonium; triperchlorate; aniline; (bromates + metals); bromine pentafluoride; n-butyraldehyde; carbides; cesium acetylene carbide; chlorates; (chlorates + metals); chlorine trifluoride; chlorosulfonic acid; cuprous nitride; diisobutylene; (dimethylbenzylcarbinol + hydrogen peroxide); epichlorohydrin; ethylene cyanohydrin; ethylene diamine; ethylene glycol; ethyleneimine; fulminates; hydrochloric acid; hydrogen; iodine heptafluoride; (undene + nitric acid); iron; isoprene; lithium silicide; mercuric nitride; mesityl oxide; powdered metals; (nitric acid + glycerides); p-nitrotoluene; pentasilver trihydroxydiaminophosphate; perchlorates; perchloric acid; (perman-ganates + benzene); (1-phenyl-2-methylpropyl alcohol + hydrogen peroxide); phosphorus; phosphorus isocyanate; picrates; potassium *tert*-butoxide; potassium chlorate; (potassium permanganate + potassium chloride); (potassium permanganate + water); beta-propiolactone; propylene oxide; pyridine; rubidium acetylene carbide; silver permanganate; sodium; sodium carbonate; sodium chlorate; sodium hydroxide; steel; styrene monomer; (toluene + nitric acid); vinyl acetate; and water. **Conditions to Avoid:** Water, combustibles, heat, ignition sources, and other incompatibles. **Hazardous Products of Decomposition:** Thermal oxidative decomposition of sulfuric acid can produce sulfur oxides.

### Section 6. Health Hazard Data

**Carcinogenicity:** The IARC,<sup>(164)</sup> NTP,<sup>(165)</sup> and OSHA<sup>(166)</sup> do not list sulfuric acid as a carcinogen. However, a number of studies have associated exposures to sulfuric acid or to acid mists in general with laryngeal cancer. In 50 confirmed cases there was an approximately four-fold increased risk among highly exposed individuals relative to matched controls. It is not known if sulfuric acid can act as a direct carcinogen, as a promoter, or in combination with other substances.<sup>(167)</sup> **Summary of Risks:** Concentrated sulfuric acid is a severe respiratory tract, skin, and eye irritant.

Continue on next page

**Section 6. Health Hazard Data, continued**

Exposure can result in severe burns, tissue damage, scarring, functional inhibition, and blindness if splashed in the eye. Although ingestion is unlikely, it may cause severe injury and death. Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory, gastrointestinal, nervous, skin or eye diseases. Target Organs: Respiratory system, eyes, skin, and teeth. Primary Entry Routes: Inhalation, skin and eye contact. Acute Effects: Vapor or mist inhalation causes coughing, sneezing, nose irritation and nose bleeds, reflex bronchospasm, shortness of breath, pulmonary edema (fluid in lungs), emphysema, and permanent changes in pulmonary function. Ingestion causes corrosion of the mucous membranes of mouth, throat, and esophagus; and epigastric pain with nausea and vomiting of mucoid and "coffee ground" material. Skin contact produces severe burns; initially the zone of contact is bleached and turns brown prior to the formation of a clearly defined ulcer. These wounds are slow in healing and may cause extensive scarring that results in functional inhibition. If burns are extensive, the outcome may prove fatal. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death. Eye contact produces deep corneal ulceration, kerato-conjunctivitis, palpebral lesions, and possible blindness. Chronic Effects: Chronic effects may include dental erosion, conjunctivitis, tracheobronchitis, emphysema, stomatitis (inflammation of the mouth mucous membranes), gastritis (inflammation of stomach mucous membranes), and dermatitis. FIRST AID Eyes: Do not allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult an ophthalmologist immediately. Skin: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Use a 2% sodium bicarbonate solution to further neutralize any  $H_2SO_4$  on the skin. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. Inhalation: Remove exposed person to fresh air and support breathing as needed. Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless otherwise advised, have that conscious and alert person drink 1 to 2 glasses of water or milk to dilute. Do not induce vomiting! Do not attempt to neutralize the acid with sodium bicarbonate. Note to Physicians: Monitor arterial blood gases, chest x-ray, and pulmonary function tests if respiratory tract irritation or respiratory depression is evident. Treat dermal irritation or burns with standard topical therapy.

**Section 7. Spill, Leak, and Disposal Procedures**

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all ignition sources, and provide adequate ventilation. Cleanup personnel should wear fully-encapsulating, vapor-protective clothing to protect against inhalation and skin or eye contact. Keep water and combustibles away from release. Stop or control leak if this can be done without undue risk. Neutralize small spills with sodium bicarbonate or a mixture of soda ash/slaked lime (50/50) and place into sealed containers for disposal. If a neutralizing agent is not available, absorb spilled sulfuric acid with vermiculite, dry sand, or earth. Never use organic material (e.g., sawdust) to absorb spill. For large spills, dike far ahead to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). Report any release in excess of 1000 lbs. Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Neutralize waste water pH between 5.5 and 8.5. Follow applicable Federal, state, and local regulations.

Aquatic Toxicity:  $LC_{50}$  (saltwater, prawns): 42.5 ppm for 48 hrs; lethal (freshwater, bluegill): 24.5 ppm/24 hr.

**EPA Designations**

Listed as a RCRA Hazardous Waste (40 CFR 261.33): Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance\* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [\* per CWA, Sec. 311(b)(4)]

Listed as a SARA Extremely Hazardous Substance (40 CFR 355): TPQ: 1000 lbs.

Listed as a SARA Toxic Chemical (40 CFR 372.65)

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

**Section 8. Special Protection Data**

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For concentrations < 25  $mg/m^3$ , use any powered, air-purifying respirator with acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 50  $mg/m^3$ , use any chemical cartridge respirator with a full facepiece and acid gas cartridge(s) in combination with a high-efficiency particulate filter. For concentrations < 80  $mg/m^3$ , use any supplied air respirator with a full facepiece and operated in pressure-demand or other positive-pressure mode. For emergency or nonroutine operations (clearing spills, reactor vessels, or storage tanks), wear an SCBA. If respirators are used, OSHA requires a respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. Other: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact.  $H_2SO_4$  has a minor to moderate effect on neoprene or rubber.<sup>(131)</sup> Ventilation: Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.<sup>(102)</sup> Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. Contaminated Equipment: Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean personal protective equipment. Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

**Section 9. Special Precautions and Comments**

Storage Requirements: Store in clearly labelled, steel containers in a cool [below 50 °F (10 °C)], dry, well-ventilated location on an acid-resistant cement floor and away from direct sunlight, combustibles, and other reactive materials. Separate from carbides, chlorates, fulminates, nitrates, picrates, and powdered metals. Protect storage containers against damage and water. Use non-sparking tools near sulfuric acid carboys, drums, tank cars, or metal storage tanks because of the possible production of hydrogen during storage. Use hand pumps for the decanting and emptying of carboys. Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Total enclosures of processes and the mechanization of handling procedures are the most effective measures to prevent contact with sulfuric acid. Protect electrical installations against the corrosive action of acid vapors. Administrative Controls: Consider preplacement and periodic physical examinations with emphasis on the respiratory tract (including pulmonary function tests), skin, eyes, and teeth.

**Transportation Data (49 CFR 172.101)**

DOT Shipping Name: Sulfuric acid

DOT Hazard Class: 8

ID No.: UN1830

DOT Packaging Group: II

DOT Label: Corrosive

Special Provisions (172.102): A3, A7, B2,

B83, B84, N34, T9, T27

**Packaging Authorizations**

a) Exceptions: 173.154

b) Non-bulk Packaging: 173.202

c) Bulk Packaging: 173.242

**Quantity Limitations**

a) Passenger, Aircraft, or Railcar: 1L

b) Cargo Aircraft Only: 30L

**Vessel Storage Requirements**

a) Vessel Stowage: C

b) Other: 14

MSDS Collection References: 26, 73, 89, 100, 101, 103, 124, 126, 127, 131, 132, 139, 140, 148, 149, 153, 159, 163, 164, 167, 171, 174, 180

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# Material Safety Data Sheet

from Genium's Reference Collection  
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No. 30

**HYDROGEN CHLORIDE**  
(Revision B)  
Issued: October 1977  
Revised: November 1988

## SECTION 1. MATERIAL IDENTIFICATION

27

**Material Name:** HYDROGEN CHLORIDE

**Description (Origin/Uses):** Used in the manufacture of pharmaceutical hydrochlorides, vinyl chloride from acetylene, alkyl chlorides from olefins, and arsenious chloride from arsenious oxide. Also used in the chlorination of rubber; as a gaseous flux for babbiting operations; and in many organic reactions involving isomerization, polymerization, and alkylation.



**Other Designations:** Anhydrous Hydrochloric Acid; HCl; CAS No. 7647-01-0

**Manufacturer:** Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS  
H 3  
F 0  
R 0  
PPG\*  
\*See sect. 8  
R 1  
I 4  
S 4  
K 0

## SECTION 2. INGREDIENTS AND HAZARDS

%

## EXPOSURE LIMITS

Hydrogen Chloride, CAS No. 7647-01-0

Ca 100

OSHA PEL  
Ceiling: 5 ppm, 7 mg/m<sup>3</sup>

ACGIH TLV, 1988-89  
TLV-Ceiling: 5 ppm, 7 mg/m<sup>3</sup>

**Toxicity Data\***  
Human, Inhalation, LC<sub>50</sub>: 1300 ppm (30 Mins)  
Rat, Inhalation, LC<sub>50</sub>: 3124 ppm (1 Hr)  
Rabbit, Oral, LD<sub>50</sub>: 900 mg/kg

\*See NIOSH, RTECS (MW4025000), for additional data with references to reproductive and mutagenic effects.

## SECTION 3. PHYSICAL DATA

**Boiling Point:** -121°F (-85°C)

**Melting Point:** -173°F (-114°C)

**Vapor Density (Air = 1):** 1.268

**Molecular Weight:** 36.27 Grams/Mole

**Solubility in Water (%):** Complete

**Appearance and Odor:** A colorless, corrosive, acidic, nonflammable gas; characteristic, suffocating, pungent odor. This material fumes strongly in moist air and provides good warning properties for voluntary removal from continued exposure. The odor is detectable at 1 to 5 ppm and becomes disagreeable and irritating at 5 to 10 ppm.

## SECTION 4. FIRE AND EXPLOSION DATA

LEL

UEL

Flash Point and Method

Autoignition Temperature

% by Volume

**Extinguishing Media:** \*Hydrogen chloride gas does not burn. Use extinguishing agents that will put out the surrounding fire. **Unusual Fire or Explosion Hazards:** In the presence of water, hydrogen chloride can react with certain metals such as iron to produce highly flammable and explosive hydrogen gas. If hydrogen gas is produced, direct all fire-fighting techniques at it. If cylinders of hydrogen chloride are in the fire area, remove them, if feasible, or cool them with a water spray to prevent the release of the hydrogen chloride by way of the fusible plug and pressure-rupture disc on the cylinders. **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Special neutralization procedures, if applicable, include the application of chemically basic substances such as soda ash or slaked lime.

## SECTION 5. REACTIVITY DATA

**Stability/Polymerization:** Hydrogen chloride is stable in closed, pressurized cylinders during routine operations at room temperature. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Hydrogen chloride gas is a very reactive, acidic, corrosive gas; use it with caution. Hazardous reactions occur between it and calcium carbide, cesium acetylene carbide, cesium carbide, lithium silicide, magnesium borate, mercuric sulfate, rubidium acetylene carbide, rubidium carbide, and sodium (Genium ref. 84). **Conditions to Avoid:** Avoid exposure to incompatible chemicals and to any other material whose compatibility with hydrogen chloride has not yet been established. Prevent accidental water contamination of any system that contains this material because it becomes corrosive to many metals in the presence of moisture. The corrosive action can liberate extremely flammable/explosive hydrogen gas. Avoid direct exposure of the hydrogen chloride gas to organic materials such as ethylene because exothermic (heat-producing) reactions are likely. Avoid excessive heat. **Hazardous Products of Decomposition:** During fires hydrogen chloride may decompose by reacting with certain metals to produce very flammable and explosive hydrogen gas (H<sub>2</sub>).

## SECTION 6. HEALTH HAZARD INFORMATION

**Carcinogenicity:** Hydrogen chloride is not listed as a carcinogen by the NTP, IARC, or OSHA.

**Summary of Risks:** Contact with hydrogen chloride causes corrosive damage to body tissue. Inhalation of hydrogen chloride at levels greater than 50 ppm for a short time causes choking, coughing, and severe irritation and damage to the mucous membranes of the upper

**SECTION 6. HEALTH HAZARD INFORMATION**

respiratory tract (URT), including ulcers of the nose, throat, and larynx. Anhydrous hydrogen chloride (HCl gas) is more damaging than hydrochloric acid must because it severely dehydrates tissue. Laryngo spasm or pulmonary edema can result from severe exposure. Repeated or prolonged exposure may cause erosion of the teeth. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** Skin, eyes, URT. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Corrosive skin and eye burns, tissue damage, and severe irritation of the URT. **Chronic Effects:** None reported. **FIRST AID:** **Eyes:** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin:** Rinse the affected area with flooding amounts of water and then wash it with soap and water. Remove contaminated clothing under a safety shower. **Inhalation:** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion:** Unlikely. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to physician:** Treatment for respiratory effects following inhalation of hydrogen chloride includes using a 5% sodium bicarbonate solution as an aerosol; maintaining a proper fluid balance (diuretics may be useful); and decreasing the inflammatory response of the lungs by administering steroids on a short-term basis (2 to 4 days). Severe inhalation exposure requires hospitalization and observation (72-hour minimum) for the delayed onset of pulmonary edema. Early intervention with serial chest X rays and respiratory support, including intubation, may be required.

**SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES**

**Spill/Leak:** Treat any hydrogen chloride gas leak as an emergency. Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately (hydrogen gas may be generated), and provide adequate ventilation. Cleanup personnel need a full set of protective clothing, including a self-contained breathing apparatus (SCBA). Try to stop the flow of the leaking hydrogen chloride gas; use a water spray to protect the personnel attempting this shutoff and to disperse the gas. If a cylinder leak cannot be stopped, remove it to a hood or open area. Detect small leaks by using concentrated ammonium hydroxide ( $\text{NH}_4\text{OH}$ ) near a suspected leak area to show up a white fume. Avoid flushing waste directly to a sewer; flush it to a retention area and neutralize the hydrochloric acid with soda ash or limestone; then dilute it with a large amount of water. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Mark any leaking cylinder "Defective" and return it to the supplier. Follow Federal, state, and local regulations.

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

**EPA Designations (40 CFR 302.4)**

CERCLA Hazardous Substance, Reportable Quantity: 5000 lbs (2270 kg), per the Clean Water Act (CWA), §311 (b) (4).

**SECTION 8. SPECIAL PROTECTION INFORMATION**

**Goggles:** Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. All respirators must be acid resistant. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any contact with this material. Outer clothing of wool (or another acid-resistant fabric) has been recommended. **Ventilation:** Install and operate general and local, maximum-explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. Make ventilation system ductwork and exposed fan components acid resistant. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment. **Other:** Design all engineering systems to be acid resistant to prevent moisture from contacting the hydrochloric acid and to prevent the gas from entering the workplace. Totally enclosed, airtight systems are recommended for industrial processes that make use of HCl gas. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale hydrogen chloride gas.

**SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS**

**Storage/Segregation:** Store in closed, pressurized containers in a cool, dry, well-ventilated area away from sources of ignition, strong oxidizers, and incompatible chemicals (see sect. 5). Protect containers from physical damage. **Special Handling/Storage:** Install pressure-reducing regulators when connecting a cylinder to a lower-pressure piping system to prevent a backflow into the original cylinder (explosion hazard). **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum-explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations to prevent static sparks. **Other Precautions:** Follow supplier's recommendations concerning the proper handling and storage procedures.

**Transportation Data (49 CFR 172.101-2)**

**DOT Shipping Name:** Hydrogen Chloride, Anhydrous

**DOT Hazard Class:** Nonflammable Gas

**ID No. UN1050**

**DOT LABEL:** Nonflammable Gas

**DOT Packaging Requirements, Packaging Exceptions:** 49 CFR 173.304.

**References:** 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

**IMO Shipping Name:** Hydrogen Chloride, Anhydrous

**IMO Hazard Class:** 2.2

**IMO Label:** Nonflammable Gas, Corrosive

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## Material Safety Data Sheets Collection:

Sheet No. 7  
Nitric Acid

Issued: 10/88

Revision: D, 9/92

### Section 1. Material Identification

**Nitric Acid (HNO<sub>3</sub>) Description:** A solution of nitrogen dioxide in water commercially available in many concentrations. Derived by oxidation of ammonia by catalytic process (heated platinum catalyst); or by direct synthesis, combining atmospheric nitrogen and oxygen in an electric arc (an expensive process, thus largely abandoned). HNO<sub>3</sub> is usually found in conjunction with nitrogen dioxide, which is considered more hazardous. Used in fertilizer production (ammonium nitrate), in photoengraving, steel etching, explosives (TNT, nitroglycerin, trinitrophenol); manufacture of metallic nitrates, sulfuric acid, aqua regia and oxalic acid, jewelry, various dyes and dyestuffs, pharmaceuticals; as a laboratory reagent, in metallurgy (mainly as a pickling agent) and the printing industry.

**Other Designations:** CAS No. 7697-37-2, aqua fortis, aqua regia, azotic acid, engravers nitrate, hydrogen nitrate, red fuming nitric acid (RFNA), white fuming nitric acid (WFNA).

**Manufacturer:** Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*<sup>(73)</sup> for suppliers list.

**Cautions:** Nitric acid is a corrosive, strong oxidizer that causes irritation or severe burns to the skin, eyes, and respiratory tract. Exposures to high levels of the concentrated acid can be fatal. Increases the flammability of combustibles. Use extreme caution when handling HNO<sub>3</sub>.

R 2	HMIS	NFPA
I 4	H 3*	0
S 4	F 0	3
K 0	R 1	1
	PPE**	ox
R 2	HMIS	NFPA
I 4	H 3*	0
S 4	F 0	3
K 0	R 1	1
	PPE**	ox
R 2	HMIS	NFPA
I 3	H 3*	0
S 3	F 0	3
K 0	R 0	0
	PPE**	-

\* Chronic effects \*\* See Sec. 8

### Section 2. Ingredients and Occupational Exposure Limits

Nitric acid, various %. Commercially available in nearly all concentrations; most common are 56 and 68%. RFNA (85%), WFNA (97.5%).

**1991 OSHA PELs**  
8-hr TWA: 2 ppm (5 mg/m<sup>3</sup>)  
15-min STEL: 4 ppm (10 mg/m<sup>3</sup>)

**1990 IDLH Level**  
100 ppm

**1990 NIOSH REL**  
8-hr TWA: 2 ppm (5 mg/m<sup>3</sup>)  
15-min STEL: 4 ppm (10 mg/m<sup>3</sup>)

**1992-93 ACGIH TLVs**  
TWA: 2 ppm (5.2 mg/m<sup>3</sup>)  
STEL: 4 ppm (10 mg/m<sup>3</sup>)

**1990 DFG (Germany) MAK**  
2 ppm (5 mg/m<sup>3</sup>)

Category I: local irritants  
Peak Exposure Limit: 2 ppm  
5 min momentary value, 8 per shift

#### 1985-86 Toxicity Data\*

Man, unreported route, LD<sub>50</sub>: 110 mg/kg; toxic effects not yet reviewed

Rat, oral, TD<sub>01</sub>: 5275 g/kg administered from 1 to 21 days of pregnancy caused post-implantation mortality and specific developmental abnormalities of the musculoskeletal system.

Rat, inhalation, LC<sub>50</sub>: 67 ppm (NO<sub>2</sub>)/4 hr; toxic effects not yet reviewed

\* See NIOSH, RTECS (QU5775000 (nitric acid), QU5900000 (RFNA), QU6000000 (WFNA)), for additional reproductive and toxicity data.

### Section 3. Physical Data

**Boiling Point:** 186.8 °F (86 °C)

**Melting Point:** -43.6 °F (-42 °C)

**Vapor Pressure:** 67% HNO<sub>3</sub> = 6.8 mm Hg at 68 °F (20 °C); 95 to 98% = 113 at 100.4 °F (38 °C)

**Saturated Vapor Density (Air = 1.2 kg/m<sup>3</sup>):** 1.212 kg/m<sup>3</sup> or 0.0757 lb/ft<sup>3</sup> (67 % HNO<sub>3</sub>)

**pH:** 1

**Molecular Weight:** 63.02

**Density:** 1.50269 at 77/39.2 °F (25/4 °C)

**Water Solubility:** Soluble (releases heat)

**Ionization Potential:** 11.95 eV

**Appearance and Odor:** Transparent, clear to yellow, fuming liquid with an acrid, suffocating odor which darkens to a brownish color on aging and exposure to light. "Fuming" nitric acid is red-brown in color.

### Section 4. Fire and Explosion Data

**Flash Point:** Noncombustible

**Autoignition Temperature:** Noncombustible

**LEL:** None reported

**UEL:** None reported

**Extinguishing Media:** For small fires (< 40% HNO<sub>3</sub>), use dry chemical, carbon dioxide (CO<sub>2</sub>), water spray, or regular foam. For large fires, use water spray, fog, or regular foam. For small fires (> 40% HNO<sub>3</sub>), use water spray, dry chemical, or soda ash. For large fires, flood area with water (do not get inside HNO<sub>3</sub> containers). Apply water from as far a distance as possible.

**Unusual Fire or Explosion Hazards:** HNO<sub>3</sub> is noncombustible but is an oxidizer which increases fire involving combustibles and can initiate an explosion. It releases flammable hydrogen gas in contact with many metals.

**Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is not effective for fires involving nitric acid. Acid-resistant clothing is needed. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Do not release runoff from fire control methods to sewers or waterways.

### Section 5. Reactivity Data

**Stability/Polymerization:** Nitric acid decomposes in air and in contact with light and organic matter. Hazardous polymerization cannot occur.

**Chemical Incompatibilities:** Nitric acid reacts explosively with combustibles, organics or readily oxidizable materials such as wood, turpentine, metal powder and hydrogen sulfide, carbides, cyanides, and alkalis; causes spattering with strong bases; is corrosive to paper, cloth and most metals (except aluminum, gold, platinum, thorium, and tantalum). Will also attack some forms of plastics, rubber, and coatings. There are at least 150 chemicals and chemical combinations which are incompatible with nitric acid. HNO<sub>3</sub> reacts with water to produce heat and toxic corrosive fumes. Refer to Genium references 126 and 159 for further detail. Conditions to Avoid: Avoid exposure to moisture, heat, and incompatibles.

**Hazardous Decomposition Products:** Thermal oxidative decomposition of HNO<sub>3</sub> produces nitrogen peroxide and toxic, irritating nitrogen oxides.

### Section 6. Health Hazards Data

**Carcinogenicity:** The IARC,<sup>(164)</sup> NTP,<sup>(165)</sup> and OSHA<sup>(164)</sup> do not list nitric acid as a carcinogen.

**Summary of Risks:** Nitric acid is very corrosive to the skin, eyes, digestive and respiratory tract or any tissue it comes in contact with. 58 to 68% (nitric acid) vapors are moderately irritating and can't be tolerated at high concentrations. 95% (nitric acid) vapors cause severe irritation at very low levels and the liquid causes 2nd and 3rd degree burns on short contact with skin or eyes. Vapor inhalation may cause pulmonary edema (fluid in lungs) leading to death. HNO<sub>3</sub> vapor or mist can slowly corrode teeth when chronically exposed. Medical Conditions Aggravated by Long-Term Exposure: Chronic respiratory diseases. Target Organs: Eyes, skin, respiratory tract, teeth.

Continue on next page



**Section 6. Health Hazard Data, continued**

**Primary Entry Routes:** Inhalation, ingestion, skin and eye contact. **Acute Effects:** Inhalation symptoms may take several hours and include throat and nose irritation, cough, chest pain, difficulty breathing, salivation, giddiness, nausea, muscular weakness, ulceration of nasal mucous membranes, pulmonary edema, and chemical pneumonia. Skin contact is moderately irritating to severely corrosive depending on % of nitric acid. Burns may penetrate deeply causing ulcers. Skin may be stained yellowish brown. Dilute solutions cause irritation and tend to harden the epithelium (outer skin layer) without destroying it.  $\text{HNO}_3$  liquid causes yellow discoloration of the eyes and severe burns which may result in permanent damage, i.e., sight loss. Ingestion produces immediate pain and digestive tract burns followed by throat swelling, convulsions, risk of stomach perforation (causing a rigid abdomen) and possible coma. **Chronic Effects:** Repeated inhalation of low concentrations may cause chronic bronchitis, tooth erosion, and/or appetite loss. Repeated exposure to  $\text{NO}_{(x)}$  such as produced by thermal decomposition of  $\text{HNO}_3$  is implicated in chronic lung diseases.

**FIRST AID**

**Eyes:** Do not allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** Quickly remove contaminated clothing (do not force removal if stuck to skin). Rinse with flooding amounts of water for at least 15 min. Apply a 5% triethanolamine solution to affected area. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that conscious and alert person drink 1 to 2 glasses of water to dilute followed by lime milk or milk of magnesia. Do not induce vomiting. Do not give sodium bicarbonate or attempt to neutralize the acid.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Observe for several hours since symptoms such as pulmonary edema may be delayed.

**Section 7. Spill, Leak, and Disposal Procedures**

**Spill/Leak:** Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Cleanup personnel should wear fully-encapsulating vapor-protective clothing. Use water spray to cool and disperse vapor. Keep combustibles away from spilled material. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in dry containers for disposal. For large spill, flush with water to containment area and neutralize with agricultural (slaked) lime, sodium bicarbonate, crushed limestone, soda ash, or lime. Report any release in excess of 1000 lb. Control runoff and dike for disposal. Follow applicable OSHA regulations (29 CFR 1910.120).

**Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

**EPA Designations**

Listed as a SARA Toxic Chemical (40 CFR 372.65)

Listed as a SARA Extremely Hazardous Substance (40 CFR 355). TPQ: 1000 lb

Listed as a RCRA Hazardous Waste (40 CFR 261.22): No. D001, Characteristic of corrosivity

Listed as a CERCLA Hazardous Substance\* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg) [\* per CWA, Sec. 311(b)(4)]

**OSHA Designations**

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Listed as a Process Safety Hazardous Chemical (29 CFR 1910.119), TQ: 500 lb

**Section 8. Special Protection Data**

**Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For < 50 ppm, use any supplied-air respirator operated in a continuous-flow mode. For < 100 ppm, use any supplied-air respirator or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. **Warning!** Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear acid-proof gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.<sup>(10)</sup> **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes. Launder contaminated work clothing before wearing. Remove this material from your shoes and clean personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

**Section 9. Special Precautions and Comments**

**Storage Requirements:** Prevent physical damage to containers. Store in aluminum, stainless steel, or glass containers on a cement floor in a cool, dry, well-ventilated area away from incompatibles (Sec. 3). Dike around storage tanks with large kirbs or sills to retain the acid in event of leakage. Keep neutralization agents on hand and install a fire hydrant in storage area. (See NFPA Code 43A). **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the eyes, skin, respiratory tract and teeth. Pulmonary function tests (FEV< FVC) are helpful. Educate workers about the hazardous properties of nitric acid.

**Transportation Data (49 CFR 172.101)**

DOT Shipping Name:  $\ast$ ,  $\dagger$ ,  $\S$ ,  $\Psi$ ,  $\omega$

DOT Hazard Class: 8

ID No.: UN1826 ( $\ast$ ), UN1796 ( $\S$ ), UN2031 ( $\Psi$ ), UN2032 ( $\omega$ )

DOT Packing Group: I ( $\dagger$ ), II ( $\Psi$ )

DOT Packaging Label: Corrosive ( $\Psi$ ), Corrosive, Oxidizer ( $\S$ ), Corrosive, Oxidizer, Poison ( $\omega$ )

Special Provisions (172.102): B2, T12, T27 ( $\ast$ ); T12, T27 ( $\dagger$ ), B2, T12, T27 ( $\S$ ); T12, T27 ( $\Psi$ ), T9, T27 ( $\Psi$ ); B2, B12, B53, T9, T27 ( $\omega$ ); 2, B9, B32, B74, T38, T43, T45 ( $\omega$ )

$\ast$  Nitrating acid mixtures spent, < 50%  $\text{HNO}_3$

$\dagger$  Nitrating acid mixtures spent, > 50%  $\text{HNO}_3$

$\S$  Nitrating acid mixtures, < 50%  $\text{HNO}_3$

$\Psi$  Nitrating acid mixtures, > 50%  $\text{HNO}_3$

$\omega$  Nitric acid other than red fuming, > 70%  $\text{HNO}_3$

$\Psi$  Nitric acid other than red fuming, < 70%  $\text{HNO}_3$

$\omega$  Nitric acid, red fuming

**Packaging Authorizations**

a) Exceptions: None

b) Non-bulk Packaging: 173.158 ( $\ast$ ), 173.227 ( $\omega$ )

c) Bulk Packaging: 173.242 ( $\Psi$ ), 173.243 ( $\S$ ), 173.244 ( $\omega$ )

**Quantity limitations**

a) Passenger Aircraft or Railcar: Forbidden

b) Cargo Aircraft Only: 30L ( $\Psi$ ), 2.5L ( $\S$ ), Forbidden ( $\omega$ )

**Vessel Stowage Requirements**

a) Vessel stowage: D

b) Other: 40 ( $\ast$ ); 40, 66, 89 ( $\dagger$ ); 40 ( $\S$ ); 40, 66, 89 ( $\Psi$ ); 110,

111 ( $\Psi$ ); 110, 111 ( $\omega$ ); 40, 66, 74, 89, 90, 95 ( $\omega$ )

**MSDS Collection References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 136, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174, 175

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